CONSTRUCTION SPECIFICATIONS

FOR

Town of Palisade, Colorado
Sewer Transfer Line

December 2025

Prepared by: J-U-B Engineers, Inc.
81-23-029

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TOWN OF PALISADE, COLORADO
SEWER TRANSFER LINE

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ADVERTISEMENT FOR BIDS

Town of Palisade
Palisade, Colorado
Sewer Transfer Project

General Notice

Town of Palisade (Owner) is requesting Bids for the construction of the following Project:

Sewer Transfer Project
81-23-029

Bids and experience documentation for the construction of the Project will be received at the Palisade Municipal Building located at 175 East 3rd Street, until February 4, 2026 at 4:00 p.m. MST.

The Project includes the following Work:

Includes the installation of approximately 4,000 LF of 8" force main, 23,000 LF 18" sanitary sewer pipe, sewer lift station, and related appurtenances between the existing Town of Palisade Lagoons and Clifton Sanitation District wastewater system. There are seasonal limitations for performing this Work, which are described in detail in Technical Section 1 – 01100. After the sewer line has been commissioned, the existing sewer lagoons are to be abandoned as part of the Project.

A version of this Project was previously advertised in 2025, but was not awarded. Some of the more significant revisions include the following:

- Addition of Lagoon Decommissioning
- Bids will be accepted for the Project as a whole or for separate portions of the work as described in C-410 Bid Form for Construction Contract (Pipeline, Lift Station, Lagoons)
- General Aggregate Excess/Umbrella insurance requirement decreased to $5,000,000
- Force main changed to DR-25
- C-200 Section 18.08 Evaluation of Qualifications made more accommodating
- BABAA is now required

The Opinion of Probable Construction Cost for the different Project components is as follows:

1. Pipeline (Section 1): $8,950,000
2. Lift Station (Section 2): $2,780,000
3. Lagoon Decommissioning (Section 3): $1,200,000

Bids are requested for the following Contract: Sewer Transfer Project

Obtaining the Bidding Documents

Information and Bidding Documents for the Project can be found at the following designated website (Issuing Office):

Rocky Mountain E-Purchasing System (https://www.bidnetdirect.com/colorado)

Bidding Documents may be downloaded from the designated website. The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding

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Documents will be offered only through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website.

Lagoon Site Visit and Pre-bid Conference

The Town of Palisade's wastewater treatment facility (lagoons and headworks) will be open for a non-mandatory site visit on January 7, 2026 from 10:00 a.m. to 2:00 p.m. due to this being a recent addition to the scope of the Project. Photographs of the facility will be posted on Bidnet.

A pre-bid conference for the Project will be held virtually on January 8, 2026 at 9:00 a.m., and the conference is mandatory. Instructions for joining this meeting will be posted on Bidnet at a later date.

Instructions to Bidders

In addition to the bid, the Contractor shall provide a separate sealed envelope containing documentation of having successfully completed 3 projects of similar scope and complexity. Provide Owner/Engineer contact information for each project. Bid and experience documentation must be submitted in separate sealed envelopes. Failure to do so may result in disqualification of the Bid.

For all further requirements regarding bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents. Award of the project is expected February 18, 2026.

Schedule Breakdown

Invitation for Bid	12/19/2025
Lagoon Site Visit	1/7/2026
Pre-Bid Meeting	1/8/2026
Bidder Questions Due	1/14/2026
Answers Due	1/21/2026
Bid Submittal Due	2/4/2026
Notice of Award	2/18/2026

Domestic Preference

This project is subject to the Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953. Absent an approved waiver, all iron, steel, manufactured products, and construction materials used in this project must be produced in the United States.

The following waivers apply to this Contract:

BABAA De Minimis, Small Grants, and Minor Components

This Advertisement is issued by:

Owner: Town of Palisade

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By: Janet Hawkinson
Title: Town Administrator
Date: December 19, 2025

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INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

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ARTICLE 1—DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders.

B. Domestic Preference – The Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953.

C. Qualifications Document – The required submittal document outlining technical approach, proposed schedule, key personnel, and past performance. No cost data is to be included in this document.

D. Cost Proposal-- The completed and submitted Bid Form with all appurtenant documents as applicable as set forth within the Bid Form instructions.

ARTICLE 2—BIDDING DOCUMENTS

2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.

2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.

2.03 Owner has *designated* a Bidding Documents Website as indicated in the Advertisement or invitation to bid. Owner recommends that Bidder register as a plan holder with the Issuing Office at such website, and obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. *Addenda issued by Owner may be received through the Issuing Office.*

2.04 *Deleted*

2.05 *Deleted*

2.06 *Electronic Documents*

A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by *the latest version of* Adobe Acrobat Reader. It is the intent of the

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Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.06.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

C. Deleted

ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 *Deleted*

3.02 *Deleted*

3.03 Bidder is to submit the following information with its Bid to demonstrate Bidder's qualifications to perform the Work:

A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.

B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.

C. Bidder's state or other contractor license number, if applicable.

D. Subcontractor and Supplier qualification information.

E. Other required information regarding qualifications.

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3.04 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.05 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

3.06 *Qualifications Document as outlined in Article 12 is required for a complete bid. Evaluation of Bidder qualifications is outlined in Article 18.*

ARTICLE 4—PRE-BID CONFERENCE

4.01 *Deleted*

4.02 *Deleted*

4.03 A mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Proposals will not be accepted from Bidders who do not attend the conference. It is each Bidder's responsibility to sign in at the pre-bid conference to verify its participation. Bidders must sign in using the name of the organization that will be submitting a Bid. A list of qualified Bidders that attended the pre-bid conference and are eligible to submit a Bid for this Project will be issued in an Addendum.

4.04 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

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

5.01 *Site and Other Areas*

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

B. The proposed work will take place within various easements with restrictions that will vary by individual property. The Contractor shall ensure all crew are aware of these restrictions and that all requirements of these restrictions are followed. These requirements are summarized in the 400 Sheets of the Drawings.

5.02 *Existing Site Conditions*

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

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:

a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.

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b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.

c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

d. Technical Data contained in such reports and drawings.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

4. *Deleted*

B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

5.03 *Other Site-related Documents*

A. Deleted

B. Deleted

C. Deleted

D. Deleted

E. No other Site-related documents are available.

5.04 *Site Visit and Testing by Bidders*

A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.

B. A Site visit is scheduled following the pre-bid conference. Maps to the Site will be available at the pre-Bid conference.

C. *Deleted*

D. Bidders visiting the Site are required to arrange their own transportation to the Site.

E. All access to the Site other than during a scheduled Site visit must be coordinated through the following Owner or Engineer contact for visiting the Site: Matt Filla (mfilla@jub.com). The only guaranteed access to the site will be during the scheduled Site visit.

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

G. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.

H. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

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

5.05 *Owner's Safety Program*

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

5.06 *Other Work at the Site*

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

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

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

A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications, and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.

B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

C. It is the responsibility of each Bidder before submitting a Bid to become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work, including but not limited to American Iron and Steel requirements as mandated by Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference which

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apply to the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.

7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows:

A. Questions shall be submitted to Matt Filla (mfilla@jub.com) by the inquiry deadline of January 14, 2026.

7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions received less than seven days prior to the date for opening of Bids may not be answered.

7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of *5* percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents. *Bid security must be at least 5 percent of the Bidder's maximum price.*

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the

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Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 9—CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.

9.02 *Deleted*

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

ARTICLE 10—SUBSTITUTE AND "OR EQUAL" ITEMS

10.01 *Deleted*

10.02 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those "or-equal" or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an "or-equal" or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer within 10 days of the issuance of the Advertisement for Bids or invitation to Bidders. Each such request must comply with the requirements of Paragraphs 7.05 and 7.06 of the General Conditions, and the review of the request will be governed by the principles in those paragraphs. *Each such request shall include the Manufacturers' Certification for Compliance with Domestic Preference requirements. Refer to the suggested Manufacturer's Certification provided in these construction Contract Documents.* The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all registered Bidders. Bidders cannot rely upon approvals made in any other manner. *Substitutes and "or-equal" materials and equipment may be proposed by Contractor in accordance with Paragraphs 7.05 and 7.06 of the General Conditions after the Effective Date of the Contract. Each such request shall include Manufacturer's Certification letter to document compliance with Domestic Preference requirements. Refer to Manufacturer's Certification Letter provided in these Contract Documents.*

10.03 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as

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supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.01 *Deleted*

11.02 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within five days after Bid opening:

A. All work to be performed by Subcontractor(s).

11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

11.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

11.05 *The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 7.07A.*

ARTICLE 12—PREPARATION OF BID

12.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8½ inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.

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12.03 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.

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

12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.

12.06 A Bid by an individual must show the Bidder's name and official address.

12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.

12.08 All names must be printed in ink below the signatures.

12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.

12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.

12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.

12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

12.13 *The Qualifications Document Shall not exceed 10 pages. The 10 pages does not include cover pages, table of contents, tabs, glossaries, resumes, and organizational charts. The Qualifications Document shall not include any cost data. To assist in the uniform evaluation of the Qualifications document, the following format shall be utilized:*

A. Technical Approach – The discussion of the technical approach shall:

1. Contain detailed explanations of proposed approaches to performing and accomplishing the work;

2. Contain a specific statement of any problems or major difficulties anticipated in performing or accomplishing the work, an evaluation of the various methods considered for resolution of the problems/difficulties, substantiation of the method(s) selected, principals or techniques which are proposed to solve the problem, and the degree of success expected;

3. Include specific statements of any interpretations, deviations, and exceptions to the work statement, specifications, or other solicitation requirements (offerors are

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cautioned that excessive deviations and exceptions to the solicitation requirements may be detrimental to the evaluation of a Qualifications Document);

4. *In accordance with the work statement, include a proposed project plan which divides the work into severable tasks or phases which indicates for each task or phase the work to be accomplished;*

5. *Include a discussion of the method(s) and resources to be used in timely preparation and transmittal of reports and submittals required by the solicitation; and*

6. *Include an estimate of the extent of anticipated subcontracting together with a list of items or work to be subcontracted.*

B. Schedule – The discussion of the schedule shall, in accordance with the work statement, and the project plan established in the technical approach, provide start/completion dates, milestone dates, and labor hours. The basis for the hour estimates shall also be included.

C. Past Performance. The discussion of the past performance shall contain descriptions of relevant past projects, including information about previous performance. Article 18 provides details on evaluation of past performance.

ARTICLE 13—BASIS OF BID

13.01 *Lump Sum*

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

13.02 *Deleted*

13.03 *Deleted*

13.04 *Deleted*

13.05 *Unit Price*

A. Bidders must submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.

B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity", which Owner or its representative has set forth in the Bid Form, for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

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

13.06 *Allowances*

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

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13.07 *Deleted*

ARTICLE 14—SUBMITTAL OF BID

14.01 The Bidding Documents include *the Bid Form, Bid security, and the other documents required to be submitted under the terms of Article 2 of the Bid Form.*

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid*, and must be accompanied by the Bid security, the name and address of Bidder, and other required documents.*

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

14.04 *A Bid shall be submitted no later than the date and time prescribed with the words "Cost Proposal" in the title. Qualifications document shall be submitted no later than the date and time prescribed with the words "Qualifications" in the title. Contractor contact information on Qualifications document must match the information provided on the Bid Form.*

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

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

15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 and submit a new Bid prior to the date and time for the opening of Bids.

15.03 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

16.01 *Deleted*

16.02 *Bids will be opened privately.*

16.03 *Cost Proposals will remain sealed and shall not be opened until after Qualifications Documents have been reviewed and evaluated as described in Article 18. If a bidder's qualifications are deemed unacceptable the cost proposal will be returned unopened. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after award of*

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contract. Cost Proposals of Contractors whose Qualification Documents are deemed to be unacceptable will not be included in abstract.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.

18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.

18.04 *Deleted*

18.05 *Evaluation of Bids*

A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

B. Deleted

C. Deleted

D. *Deleted*

E. Deleted

F. Deleted

G. If Owner awards the contract for the Work, Owner will award the Contract to the Bidder whose Bid is in the best interests of the Project.

18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

18.07 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

18.08 *Evaluation of Qualifications*

A. In evaluating Qualifications, Owner will consider whether or not the Qualifications Document complies with the prescribed requirements, set forth in Article 12.

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1. *The proposal shall be evaluated on the following criteria:*

    a. *Technical Approach – The evaluation will be based upon the extent of the offeror's understanding of the project and the completeness, reasonableness, and feasibility of the proposed method(s) to complete the project. The approach for completing, and experience with, the following tasks shall be provided.*

        1) *Sewer Line Installations*

            i) *Similar size and length (a minimum of 10,000 LF of pipe installation as part of a single project is expected).*

            ii) *Shallow pipe slopes*

            iii) *Deep trenches and de-watering*

            iv) *Stakeholder/property owner engagement*

            v) *Narrow corridors and work zones*

            vi) *Multiple crews (if proposed in approach)*

        2) *Complex Industrial Facilities (such as lift stations)*

            i) *Pump installation*

            ii) *Reinforced concrete structures*

            iii) *Facility piping*

            iv) *Industrial equipment installation*

    b. *Schedule – The evaluation will be based upon the extent of the offeror's understanding of, and the completeness and feasibility of, the proposed schedule.*

    c. *Past Performance – The quality of the offeror's past performance and that of any proposed subcontractors will be evaluated to determine the capability of the offeror and of significant and/or critical subcontractors to perform the work*

18.09 *Owner will evaluate the bids on both the Qualifications Document and the Cost Proposal to determine the most highly qualified Bidder offering the most attractive cost proposal. Cost Proposals and Qualifications Documents are of equal merit in Bid selection. The owner specifically reserves the right to select a bid other than the bid with the lowest cost proposal if owner finds a higher cost proposal to be in the best interest of the owner. Owner further reserves the right to waive any formalities of the Qualifications Document or Cost Proposal and any irregularities in the submitted bids.*

ARTICLE 19—BONDS AND INSURANCE

19.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds, other required bonds (if any),

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

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

ARTICLE 20—SIGNING OF AGREEMENT

20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

20.02 *TABOR: In accordance with Article X, Section 20(4)(b) of the Colorado Constitution, any final contract for the project and Work shall neither create nor be construed to create any multiple-fiscal year direct or indirect Town debt or other financial obligation whatsoever. Bidder and Town recognize that if the final contract will be dependent upon the continuing availability and appropriation of funds beyond the terms of the Town's current fiscal year period, that financial obligations of the Town payable after the current fiscal year are contingent upon funds for that purpose being appropriated, budgeted and otherwise made available*

ARTICLE 21—SALES AND USE TAXES

21.01 The Owner is exempt from Colorado state sales and use taxes on materials and equipment that are to be permanently incorporated into the Work (Exemption No. 09803910). These taxes shall not be included in the Bid. Refer to Paragraph SC-7.10 of the Supplementary Conditions for additional information..

ARTICLE 22—*FEDERAL REQUIREMENTS*

22.01 *If the contract project is in excess of $100,000, provisions of the Contract Work Hours and Safety Standards Act at 29 CFR 5.5(b) apply.*

22.02 *Federal requirements in Article 19 of the Supplementary Conditions apply to this Contract.*

22.03 *American Iron and Steel requirements apply to this project. Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference applies an American Iron and Steel requirement to this project. All listed iron and steel products used in this project must be produced in the United States. The term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials. The deminimis and minor components waiver apply to this contract.*

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BID FORM FOR CONSTRUCTION CONTRACT

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

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to:

Town of Palisade
175 East 3rd Street
Palisade, CO 81526

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

ARTICLE 2—ATTACHMENTS TO THIS BID

2.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security;

B. List of Proposed Subcontractors;

C. List of Proposed Suppliers;

D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids;

E. Contractor's license number as evidence of Bidder's State Contractor's License or a covenant by Bidder to obtain said license within the time for acceptance of Bids;

F. Required Bidder Qualification Statement with supporting data;

G. If Bid amount exceeds $100,000, signed RD Instruction 1940-Q, Exhibit A-1, Certification for Contracts, Grants, and Loans.

H. Manufacturers' Certification letter of compliance with Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017) and subsequent statutes mandating domestic preference for all equals or substitutes approved by Addenda for American Iron and Steel products as provided in these Contract Documents.

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ARTICLE 3—BASIS OF BID—LUMP SUM BID AND UNIT PRICES

3.01 *Deleted*

3.02 *Unit Price Bids*

A. The project has been split into three Sections for the purposes of bidding

Section 1 – Pipeline Work Outside the Lift Station,

Section 2 – Lift Station,

Section 3 – Lagoon Abandonment

The Contractor has the option to provide a bid for each of the three Sections individually or combined. The Contractor is not required to provide a bid for any or all Sections they don't want their bid to be considered for selection. The Town has the option to select the Contractor/s which will provide the overall best value to the project.

B. Section 1. Bidder will perform the following Work at the indicated unit prices:

SECTION 1 Pipeline Work Outside the Lift Station					
Item No.	**Description**	**Unit**	**Estimated Quantity**	**Bid Unit Price**	**Bid Amount**
1	Section 1 Mobilization	LS	1	$	$
2	Remove Existing Pipe	LF	970	$	$
3	Removal of Manhole	EA	1	$	$
4	16" A.C. Pipeline Replacement	LS	1	$	$
5	Wetland Protection and Restoration	SY	1,345	$	$
6	Piezometer Abandonment	EA	4	$	$
7	Remove and Replace Wingwall (In-Kind)	LS	1	$	$
8	Pipeline Plugging	EA	13	$	$
9	Removal of Asphalt Mat (Full-Depth)	SY	5,340	$	$
10	Removal of Asphalt Mat (Planing)	SY	1,359	$	$
11	Unclassified Excavation (Canal Road Surface)	CY	4,431	$	$
12	8" PVC Restrained Joint Force Main (DR-25 C900) (Includes Type A Bedding and Haunching Material)	LF	4,001	$	$
13	12" PVC Restrained Joint Force Main (DR-25 C900) (Includes Type A Bedding and Haunching Material)	LF	20	$	$
14	8" 11.25 Degree Restrained Bend (R>1.5D)	EA	2	$	$
15	8" 22.5 Degree Restrained Bend (R>1.5D)	EA	2	$	$

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SECTION 1 Pipeline Work Outside the Lift Station					
Item No.	**Description**	**Unit**	**Estimated Quantity**	**Bid Unit Price**	**Bid Amount**
16	8" 45 Degree Restrained Bend (R>1.5D)	EA	1	$	$
17	12"x8" Restrained Reducer	EA	1	$	$
18	21" Gravity Sewer Pipe (SDR-35 PVC) (Includes Type A Bedding and Haunching Material)	LF	102		
19	18" Gravity Sewer Pipe (SDR-35 PVC) (Includes Type A Bedding and Haunching Material)	LF	23,118	$	$
20	Sewer Service Stub-Out	EA	28	$	$
21	Sanitary Sewer Basic MH 60" Dia	EA	59	$	$
22	MH Barrel Section D>5' 60"	VLF	290	$	$
23	Force Main Discharge Manhole (MH-23) (Polymer Concrete)	LS	1	$	$
24	MH Coating	VLF	590	$	$
25	Polymer Concrete MH 60” Dia	EA	3	$	$
26	Polymer Concrete MH Barrel Section D>5’ 60”	VLF	17	$	$
27	Polymer Concrete MH 72” Dia	EA	1	$	$
28	Polymer Concrete MH Barrel Section D>5’ 72”	VLF	15	$	$
29	Riverbend Irrigation Structure	LS	1	$	$
30	Drain Crossings	EA	3	$	$
31	Driveway Gate	EA	9	$	$
32	Fence Gate	EA	8	$	$
33	Canal Road Surface (9" Thick Class 6 ABC)	Ton	7,957	$	$
34	Aggregate Base Course (Class 6) (9" Thick) (For Paved Areas)	Ton	2,397	$	$
35	Hot Bituminous Pavement (3" Thick) (Grading SX, PG 64-22) (One 3" Lift)	Ton	884	$	$
36	Hot Bituminous Pavement (T-Top Mat) (2" Thick) (Grading SX, PG 64-22) (One Lift)	Ton	739	$	$
37	Granular Stabilization Material (Type B) (Crushed Rock) (24" Thick Min.) (Includes haul and disposal of unsuitable excavated material) (Assumed Unit Weight = 138 lbs/ft3) (Assumed 2' Thick, 100%)	Ton	21,435	$	$

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SECTION 1 Pipeline Work Outside the Lift Station					
Item No.	**Description**	**Unit**	**Estimated Quantity**	**Bid Unit Price**	**Bid Amount**
38	Imported Trench Backfill (Class 3) (Includes haul and disposal of unsuitable excavated material) (Assumed material unit weight = 133 lbs/ft3) (Assumed 75%)	Ton	57,449	$	$
39	Canal Crossing	LS	1	$	$
40	Pit Run Fill	Ton	1,592	$	$
41	Canal Wall Soil Replacement	CY	1,533	$	$
42	Property Removals and Restoration	LS	1	$	$
43	Riverbend Park Removals and Restoration	LS	1	$	$
44	Erosion Control (Complete-in-place)	LS	1	$	$
45	Portable Sanitary Facility	EA	3	$	$
46	Concrete Washout Facility	EA	3	$	$
47	Stabilized Construction Entrance	EA	3	$	$
48	Dust Abatement	Day	300	$	$
49	Bypass Pumping	LS	1	$	$
50	Pavement Marking Paint	GAL	72	$	$
51	Construction Surveying (Includes As-Built Drawings)	LS	1	$	$
52	Traffic Control Plan	LS	1	$	$
53	Traffic Control (Complete in Place)	LS	1	$	$
54	Preparation and Distribution of Newsletters	LS	1	$	$
55	Potholing	HR	80	$	$
56	Quality Control Testing	LS	1	$	$
57	Minor Contract Revisions	LS	1	$ 150,000	$ 150,000
58	Wildlife Biologist	HR	8	$	$
Total of All Unit Price Bid Items (Only Section 1)					$

C. Section 2. Bidder will perform the following Work at the indicated unit prices:

SECTION 2 Lift Station					
Item No.	**Description**	**Unit**	**Estimated Quantity**	**Bid Unit Price**	**Bid Amount**
59	Section 2 Mobilization	LS	1	$	$
60	Lift Station	LS	1	$	$
Total of All Unit Price Bid Items (Only Section 2)					$

D. Section 3. Bidder will perform the following Work at the indicated unit prices:

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SECTION 3 Lagoon Abandonment					
Item No.	**Description**	**Unit**	**Estimated Quantity**	**Bid Unit Price**	**Bid Amount**
61	Section 3 Mobilization	LS	1	$	$
62	Headworks Demolition	LS	1	$	$
63	Sludge/Liner Disposal	TON	24,250	$	$
Total of All Unit Price Bid Items (Only Section 3)					$

E. Bidder acknowledges that:

1. each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and

2. estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Work will be based on actual quantities, determined as provided in the Contract Documents.

3.03 *Total Bid Price (Lump Sum and Unit Prices). Contractor to provide a Total Bid Price for each of the options below in which the Contractor would like their bid to be considered for selection. If Bids will not be provided for an option, write "N/A" in the associated price box.*

Section 1 Only (Total of all Lump Sum and Unit Price Bids)	$
Section 2 Only (Total of all Lump Sum and Unit Price Bids)	$
Section 3 Only (Total of all Lump Sum and Unit Price Bids)	$
Combined Sections 1, 2, and 3 (Total of all Lump Sum and Unit Price Bids)	$

ARTICLE 4—*DELETED*

ARTICLE 5—*DELETED*

ARTICLE 6—TIME OF COMPLETION

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

6.02 *Deleted*.

6.03 *Deleted*.

6.04 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

7.01 *Bid Acceptance Period*

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

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7.02 *Instructions to Bidders*

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

7.03 *Receipt of Addenda*

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 8—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

8.01 *Bidder's Representations*

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

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work*, including all Domestic Preference requirements*.
4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data

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are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

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

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

10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

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

8.02 *Bidder's Certifications*

A. The Bidder certifies the following:

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

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

3. Bidder has not solicited or induced any individual or entity to refrain from bidding.

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:

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

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

c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

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

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BIDDER hereby submits this Bid as set forth above:

Bidder:

_____

(typed or printed name of organization)

By: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

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

Attest: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

Address for giving notices:

_____

_____

Bidder's Contact:

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Phone: _____

Email: _____

Address:

_____

_____

_____

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

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CERTIFICATION FOR CONTRACTS, GRANTS AND LOANS

The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant or Federal loan, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant or loan.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant or loan, the undersigned shall complete and submit Standard Form - LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including contracts, subcontracts, and subgrants under grants and loans) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

_____ _____

(name) (date)

_____

(title)

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BID BOND (PENAL SUM FORM)

Bidder	**Surety**
Name: **[Full formal name of Bidder]** Address *(principal place of business)*: **[Address of Bidder's principal place of business]**	Name: **[Full formal name of Surety]** Address *(principal place of business)*: **[Address of Surety's principal place of business]**
Owner	**Bid**
Name: **[Full formal name of Owner]** Address *(principal place of business)*: **[Address of Owner's principal place of business]**	Project *(name and location)*: **[Owner project/contract name, and location of the project]** Bid Due Date: **[Enter date bid is due]**
Bond Penal Sum: **[Amount]** Date of Bond: **[Date]**	

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

Bidder	Surety
_____ *(Full formal name of Bidder)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature) (Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title:	Title:

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

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

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ARTICLE 1—GENERAL INFORMATION

1.01 Provide contact information for the Business:

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

1.02 Provide information on the Business's organizational structure:

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

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

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

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

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

ARTICLE 2—LICENSING

2.01 Provide information regarding licensure for Business:

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

ARTICLE 3—DIVERSE BUSINESS CERTIFICATIONS

3.01 Provide information regarding Business's Diverse Business Certification, if any. Provide evidence of current certification.

Certification	Certifying Agency	Certification Date
☐ Disadvantaged Business Enterprise		
☐ Minority Business Enterprise		
☐ Woman-Owned Business Enterprise		
☐ Small Business Enterprise		
☐ Disabled Business Enterprise		
☐ Veteran-Owned Business Enterprise		
☐ Service-Disabled Veteran-Owned Business		
☐ HUBZone Business (Historically Underutilized) Business		
☐ Other		
☐ None		

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ARTICLE 4—SAFETY

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

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

4.02 Provide Worker's Compensation Insurance Experience Modification Rate (EMR), Total Recordable Frequency Rate (TRFR) for incidents, and Total Number of Recorded Manhours (MH) for the last 3 years and the EMR, TRFR, and MH history for the last 3 years of any proposed Subcontractor(s) that will provide Work valued at 10% or more of the Contract Price. Provide documentation of the EMR history for Business and Subcontractor(s).

Year									
Company	EMR	TRFR	MH	EMR	TRFR	MH	EMR	TRFR	MH

ARTICLE 5—FINANCIAL

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

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

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ARTICLE 6—SURETY INFORMATION

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

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

ARTICLE 7—INSURANCE

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

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

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ARTICLE 8—CONSTRUCTION EXPERIENCE

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

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

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

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venturer:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been barred from contracting by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been released from a bid in the past 5 years? ☐ Yes ☐ No				
Defaulted on a project or failed to complete any contract awarded to it? ☐ Yes ☐ No				
Refused to construct or refused to provide materials defined in the contract documents or in a change order? ☐ Yes ☐ No				
Been a party to any currently pending litigation or arbitration? ☐ Yes ☐ No				
Provide full details in a separate attachment if the response to any of these questions is Yes.				

8.03 List all projects currently under contract in Schedule A and provide indicated information.

8.04 List a minimum of three and a maximum of six projects completed in the last 5 years in Schedule B and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.

8.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 9—REQUIRED ATTACHMENTS

9.01 Provide the following information with the Statement of Qualifications:

A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.

B. Diverse Business Certifications if required by Paragraph 3.01.

C. Certification of Business's safety performance if required by Paragraph 4.02.

D. Financial statements as required by Paragraph 5.01.

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E. Attachments providing additional information as required by Paragraph 8.02.

F. Schedule A (Current Projects) as required by Paragraph 8.03.

G. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 8.04.

H. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 8.05.

I. Additional items as pertinent.

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This Statement of Qualifications is offered by:

Business: _____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(date signed)

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

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

_____

_____

_____

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

_____

_____

_____

Phone: _____

Email: _____

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Schedule A—Current Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

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Schedule B—Previous Experience with Similar Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

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Schedule B—Previous Experience with Similar Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

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Schedule C—Key Individuals

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

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

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

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NOTICE OF AWARD

Date of Issuance:			
Owner:	Town of Palisade	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	81-23-029
Project:	Sewer Transfer Project		
Contract Name:			
Bidder:			
Bidder's Address:			

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

[Describe Work, alternates, or sections of Work awarded]

The Contract Price of the awarded Contract is $**[Contract Price]**. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

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

☐ Drawings will be delivered separately from the other Contract Documents.

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

1. Deliver to Owner **[number of copies sent]** counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any): **[Describe other conditions that require Successful Bidder's compliance]**

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

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: **Town of Palisade**

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Copy: Engineer

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

This Agreement is by and between the Town of Palisade ("Owner") and **[name of contracting entity]** ("Contractor").

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

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

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

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Includes the installation of approximately 5 miles of 8" and 18" sanitary sewer pipe, sewer lift station, and related appurtenances between the existing Town of Palisade Lagoons and Clifton Sanitation District wastewater system.

ARTICLE 3—ENGINEER

3.01 The Owner has retained J-U-B Engineers, Inc. ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.02 The part of the Project that pertains to the Work has been designed by "Engineer".

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

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

4.02 *Contract Times: Dates*

A. The punchlist items required to transport wastewater to the CSD will be substantially complete on or before March 15, 2027, with all other punchlist items substantially complete by April 15, 2027. Final punch list items to be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before May 15, 2027.

4.03 *Deleted*

4.04 *Deleted*

4.05 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and

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Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner $8,800 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $8,800 for each day that expires after such time until the Work is completed and ready for final payment.
3. *Deleted*.
4. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

C. *Deleted*

4.06 *Deleted*

ARTICLE 5—CONTRACT PRICE

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

A. *Deleted*

B. *Deleted*

C. *Deleted*

D. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the 30th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted

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in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

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

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

6.03 *Final Payment*

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

6.04 *Consent of Surety*

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

6.05 *Interest*

A. All amounts not paid when due will bear interest at the maximum legal rate per annum.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

A. The Contract Documents consist of all of the following:
    1. This Agreement.
    2. Bonds:
        a. Performance bond (together with power of attorney).
        b. Payment bond (together with power of attorney).
    3. General Conditions.
    4. Supplementary Conditions.

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5. Specifications as listed in the table of contents of the project manual (copy of list attached).
6. *Deleted*
7. Drawings listed on the attached sheet index.
8. Addenda (numbers **[number]** to **[number]**, inclusive).
9. Exhibits to this Agreement (enumerated as follows):
    a. **[list exhibits]**
10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.
    d. Field Orders.
    e. Warranty Bond, if any.

B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 7.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor's Representations*

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in

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the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

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

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

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

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

8.02 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

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

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

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

8.03 *Standard General Conditions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

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

This Agreement will be effective on **[indicate date on which Contract becomes effective]** (which is the Effective Date of the Contract).

Owner:

_____
(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

_____

_____

_____

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

_____

_____

_____

Phone: _____

Email: _____

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

Contractor:

_____
(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

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

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

_____

_____

_____

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

_____

_____

_____

Phone: _____

Email: _____

License No.: _____
(where applicable)

State: _____

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NOTICE TO PROCEED

Owner:	Town of Palisade	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	81-23-029
Contractor:		Contractor's Project No.:	
Project:	Sewer Transfer Project		
Contract Name:			
Effective Date of Contract:			

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on **[date Contract Times are to start]** pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement: **[Select one of the following two alternatives, insert dates or number of days, and delete the other alternative.]**

The date by which Substantial Completion must be achieved is **[date for Substantial Completion, from Agreement]**, and the date by which readiness for final payment must be achieved is **[date for readiness, from Agreement]**.

[or]

The number of days to achieve Substantial Completion is **[number of days, from Agreement]** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of **[date, calculated from commencement date above]**; and the number of days to achieve readiness for final payment is **[number of days, from Agreement]** from the commencement date of the Contract Times, resulting in a date for readiness for final payment of **[date, calculated from commencement date above]**.

Before starting any Work at the Site, Contractor must comply with the following:

[Note any access limitations, security procedures, or other restrictions]

Owner:	Town of Palisade
By *(signature)*:	
Name *(printed)*:	
Title:	
Date Issued:	

Copy: Engineer

EJCDC® C-550, Notice to Proceed.
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PERFORMANCE BOND

Contractor Name: **[Full formal name of Contractor]** Address *(principal place of business)*: **[Address of Contractor's principal place of business]**	**Surety** Name: **[Full formal name of Surety]** Address *(principal place of business)*: **[Address of Surety's principal place of business]**
Owner Name: **Town of Palisade** Mailing address *(principal place of business)*: **175 East 3rd Street** **Palisade, CO 81526**	**Contract** Description *(name and location)*: **[Owner's project/contract name, and location of the project]** Contract Price: **[Amount from Contract]** Effective Date of Contract: **[Date from Contract]**

Bond

Bond Amount: **[Amount]**

Date of Bond: **[Date]**

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 16

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

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

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

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

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

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

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

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

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

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

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

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

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

    5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

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

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

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

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

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

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

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

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

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

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

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

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

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

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

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statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

    14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

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

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

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

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

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

16. Modifications to this Bond are as follows: None

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PAYMENT BOND

Contractor	**Surety**
Name: **[Full formal name of Contractor]** Address *(principal place of business)*: **[Address of Contractor's principal place of business]**	Name: **[Full formal name of Surety]** Address *(principal place of business)*: **[Address of Surety's principal place of business]**
Owner	**Contract**
Name: **Town of Palisade** Mailing address *(principal place of business)*: **175 East 3rd Street** **Palisade, CO 81526**	Description *(name and location)*: **[Owner's project/contract name, and location of the project]** Contract Price: **[Amount, from Contract]** Effective Date of Contract: **[Date, from Contract]**

Bond

Bond Amount: **[Amount]**

Date of Bond: **[Date]**

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

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

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

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

EJCDC® C-615, Payment Bond.
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1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond will arise after the following:

    5.1. Claimants who do not have a direct contract with the Contractor

        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2. Pay or arrange for payment of any undisputed amounts.

    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

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8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

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

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

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

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

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

        16.1.1. The name of the Claimant;

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

        16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

        16.1.4. A brief description of the labor, materials, or equipment furnished;

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16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

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

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

16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

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

18. Modifications to this Bond are as follows: None

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Contractor's Application for Payment

Owner:		**Owner's Project No.:**	
Engineer:		**Engineer's Project No.:**	
Contractor:		**Contractor's Project No.:**	
Project:			
Contract:			
Application No.:		**Application Date:**	
Application Period:	**From**	**to**	

1. Original Contract Price			$ -
2. Net change by Change Orders			$ -
3. Current Contract Price (Line 1 + Line 2)			$ -
4. Total Work completed and materials stored to date (Sum of Column G Lump Sum Total and Column J Unit Price Total)			$ -
5. Retainage			
a. _____ X	$ -	Work Completed	$ -
b. _____ X	$ -	Stored Materials	$ -
c. Total Retainage (Line 5.a + Line 5.b)			$ -
6. Amount eligible to date (Line 4 - Line 5.c)			$ -
7. Less previous payments (Line 6 from prior application)			
8. Amount due this application			$ -
9. Balance to finish, including retainage (Line 3 - Line 4)			$ -

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:
(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;
(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such liens, security interest, or encumbrances); and
(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor: _____

Signature: _____ **Date:** _____

Recommended by Engineer	**Approved by Owner**
By:	**By:**
Title:	**Title:**
Date:	**Date:**
Approved by Funding Agency	
By:	**By:**
Title:	**Title:**
Date:	**Date:**

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Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner: _____ **Owner's Project No.:** _____
Engineer: _____ **Engineer's Project No.:** _____
Contractor: _____ **Contractor's Project No.:** _____
Project: _____
Contract: _____

Application No.: _____ **Application Period:** **From** _____ **to** _____ **Application Date:** _____

A	B	C	D	E	F	G	H	I
			Work Completed					
Item No.	Description	Scheduled Value ($)	(D + E) From Previous Application ($)	This Period ($)	Materials Currently Stored (not in D or E) ($)	Work Completed and Materials Stored to Date (D + E + F) ($)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) ($)
Original Contract								
			-			-		-
						-		-
						-		-

Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner: _____ **Owner's Project No.:** _____
Engineer: _____ **Engineer's Project No.:** _____
Contractor: _____ **Contractor's Project No.:** _____
Project: _____
Contract: _____

Application No.: _____ **Application Period:** **From** _____ **to** _____ **Application Date:** _____

A	B	C	D	E	F	G	H	I
			Work Completed					
Item No.	Description	Scheduled Value ($)	(D + E) From Previous Application ($)	This Period ($)	Materials Currently Stored (not in D or E) ($)	Work Completed and Materials Stored to Date (D + E + F) ($)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) ($)
Change Orders								
						-		-
						-		-
						-		-

Progress Estimate - Unit Price Work

Contractor's Application for Payment

Owner: _____
Engineer: _____
Contractor: _____
Project: _____
Contract: _____

Owner's Project No.: _____
Engineer's Project No.: _____
Contractor's Project No.: _____

Application No.: _____ Application Period: From _____ to _____ Application Date: _____

A	B	C	D	E	F	G	H	I	J	K	L
		Contract Information				Work Completed					
Bid Item No.	Description	Item Quantity	Units	Unit Price ($)	Value of Bid Item (C X E) ($)	Estimated Quantity Incorporated in the Work	Value of Work Completed to Date (E X G) ($)	Materials Currently Stored (not in G) ($)	Work Completed and Materials Stored to Date (H + I) ($)	% of Value of Item (J / F) (%)	Balance to Finish (F - J) ($)
Original Contract											
					-		-		-		-
					-		-		-		-
					-		-		-		-

Progress Estimate - Unit Price Work

Contractor's Application for Payment

Owner: _____
Engineer: _____
Contractor: _____
Project: _____
Contract: _____

Owner's Project No.: _____
Engineer's Project No.: _____
Contractor's Project No.: _____

Application No.: _____ Application Period: From _____ to _____ Application Date: _____

A	B	C	D	E	F	G	H	I	J	K	L
		Contract Information				Work Completed					
Bid Item No.	Description	Item Quantity	Units	Unit Price ($)	Value of Bid Item (C X E) ($)	Estimated Quantity Incorporated in the Work	Value of Work Completed to Date (E X G) ($)	Materials Currently Stored (not in G) ($)	Work Completed and Materials Stored to Date (H + I) ($)	% of Value of Item (J / F) (%)	Balance to Finish (F - J) ($)
Change Orders											
					-		-		-		-
					-		-		-		-
					-		-		-		-

Stored Materials Summary

Contractor's Application for Payment

Owner: _____
Engineer: _____
Contractor: _____
Project: _____
Contract: _____

Owner's Project No.: _____
Engineer's Project No.: _____
Contractor's Project No.: _____

Application No.: _____ **Application Period:** From _____ to _____ **Application Date:** _____

A	B	C	D	E	F	G	H	I	J	K	L	M
						Materials Stored			Incorporated in Work			
Item No. (Lump Sum Tab) or Bid Item No. (Unit Price Tab)	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Description of Materials or Equipment Stored	Storage Location	Application No. When Materials Placed in Storage	Previous Amount Stored ($)	Amount Stored this Period ($)	Amount Stored to Date (G+H) ($)	Amount Previously Incorporated in the Work ($)	Amount Incorporated in the Work this Period ($)	Total Amount Incorporated in the Work (J+K) ($)	Materials Remaining in Storage (I-L) ($)
								-			-	-
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					Totals	$ -	$ -	$ -	$ -	$ -	$ -	$ -

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CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Town of Palisade	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	81-23-029
Contractor:		Contractor's Project No.:	
Project:	Sewer Transfer Project		
Contract Name:			

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

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

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

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 Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

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 must be as provided in the Contract, except as amended as follows:

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

[List amendments to Owner's Responsibilities]

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

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

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 Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

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

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

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requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

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

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

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

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

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

26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

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

32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

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33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

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

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

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

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43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

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

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

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

49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

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

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1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

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

1. does not conform to the Contract Documents;

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

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

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

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

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

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

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F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

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

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

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into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

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

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

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

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

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ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

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

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

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

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

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

3.02 *Reference Standards*

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

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

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inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

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

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

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B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

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

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

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

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

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established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. Abnormal weather conditions;

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

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D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

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

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

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B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

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

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

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and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

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

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

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

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

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

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

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

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5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

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

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

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

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

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Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

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3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

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

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

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

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

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or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

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

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

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of construction to be employed by Contractor, and safety precautions and programs incident thereto;

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

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

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

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conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

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Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

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

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

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

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

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L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

5. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

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4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

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Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

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6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

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

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

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

7.03 *Labor; Working Hours*

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

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

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

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

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

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

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

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

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

4) is not objectionable to Owner.

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

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

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

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

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

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

    a. will certify that the proposed substitute item will:

        1) perform adequately the functions and achieve the results called for by the general design;

        2) be similar in substance to the item specified; and

        3) be suited to the same use as the item specified.

    b. will state:

        1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

        2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

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

    c. will identify:

        1) all variations of the proposed substitute item from the item specified; and

        2) available engineering, sales, maintenance, repair, and replacement services.

    d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

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

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

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H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

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

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

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

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

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

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7.09 *Permits*

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

7.10 *Taxes*

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

7.11 *Laws and Regulations*

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

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

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

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7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

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

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

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

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

7.15 *Emergencies*

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

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

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

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

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3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

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

C. *Engineer's Review of Shop Drawings and Samples*

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

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

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document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

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

D. *Resubmittal Procedures for Shop Drawings and Samples*

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

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

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

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

   a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

   b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

   c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

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d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

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

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

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

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

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

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

5. Any review and approval of a Shop Drawing or Sample submittal;

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

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9. Any correction of defective Work by Owner.

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

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

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D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

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E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

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

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

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

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

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B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

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

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

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

9.03 *Furnish Data*

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

9.04 *Pay When Due*

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

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

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

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

9.07 *Change Orders*

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

9.08 *Inspections, Tests, and Approvals*

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

9.09 *Limitations on Owner's Responsibilities*

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

9.10 *Undisclosed Hazardous Environmental Condition*

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

9.11 *Evidence of Financial Arrangements*

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

9.12 *Safety Programs*

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

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

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ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

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

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

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

10.05 *Determinations for Unit Price Work*

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

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

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

10.07 *Limitations on Engineer's Authority and Responsibilities*

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

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

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

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

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

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ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

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

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

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

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

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

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1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:
   1. A mutually acceptable fixed fee; or
   2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
      a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
      b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
      c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
      d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
      e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
      f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

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11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

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

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

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Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

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

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

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and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

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

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

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2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

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

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

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

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

5. Other costs consisting of the following:

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

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

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consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

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

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

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

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

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

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

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, 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 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

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

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

13.02 *Allowances*

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

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

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thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

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

14.01 *Access to Work*

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

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

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D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

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

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

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losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

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

14.05 *Uncovering Work*

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

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

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or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

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

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

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

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establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

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4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work;

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

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

D. *Payment Becomes Due*

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

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

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b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

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

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

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submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

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significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

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

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

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d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

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

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

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;
2. correct such defective Work;
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

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

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

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

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

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provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

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

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18.03 *Cumulative Remedies*

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

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Assignment of Contract*

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

18.09 *Successors and Assigns*

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

18.10 *Headings*

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

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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

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

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, "Paragraph SC-4.05."

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

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

The Change Order form to be used on this Project is EJCDC C-941 (2018). Agency approval is required before Change Orders are effective.

SC-1.01.A.30 – Add the following at the end of the Paragraph:

For the purposes of Rural Development, this term is synonymous with the term "applicant" as defined in 7 CFR 1780.7 (a) (1), (2) and (3) and is an entity receiving financial assistance from the federal programs.

SC 1.01.A.50 Add the following language at the end of the last sentence of Paragraph 1.01.A.50:

The Work Change Directive form to be used on this Project is EJCDC C-940 (2018). Agency approval is required before a Work Change Directive is issued.

SC-1.01.A.50 – Add the following at the end of the Paragraph:

The Work Change Directive form to be used on this Project is EJCDC C-940 (2018). Agency approval is required before a Work Change Directive is issued.

SC-1.01.A.51 – Add the following new paragraph immediately after Paragraph 1.01.A.50:

51. Agency – The Project is financed in whole or in part by USDA Rural Utilities Service pursuant to the Consolidated Farm and Rural Development Act (7 U.S.C. Section 1921 et seq.). The Rural Utilities Service programs are administered through the USDA Rural Development offices; therefore, the Agency for these documents is USDA Rural Development.

SC-1.01.A.52 – Add the following new paragraph with the title "Domestic Preference Definitions" immediately after Paragraph 1.01.A.51:

52.a Build America, Buy America Act (BABAA) – Requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901- 70953-58 mandating domestic preference that all iron and steel, manufactured products, and construction materials are produced in the United States, in accordance with 2 CFR part 184.

52.b Construction Materials – Those articles, materials, or supplies — other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates

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such as stone, sand, or gravel; or aggregate binding agents or additives— that are or consist primarily of: non-ferrous metals, plastic and polymer- based products, glass, lumber or drywall.

52.c Contractor's Certification – A certification submitted by Contractor that, to the best of the Contractor's knowledge and belief, all Work complies with Domestic Preference requirements.

52.d De Minimis – Materials and products that represent a small portion of an infrastructure project, specifically no more than 5% of the project costs up to a maximum of $1,000,000,

52.e Domestic Preference – The Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953.

52.f Engineer's Certification – Documentation submitted by the Engineer that Drawings, Specifications, and Bidding Documents comply with Domestic Preference requirements.

52.g Manufactured Product – Items assembled out of components, or otherwise made or processed from raw materials into finished products. Manufactured products must be manufactured (assembled) in the United States, and the cost of components that were mined, produced, or manufactured in the United States must be greater than 55 percent of the total cost of all components of the product.

52.h Manufacturer's Certification – Documentation provided by the Manufacturer stating that Domestic Preference requirements have been satisfied for all provided items. Manufacturers' Certifications must include (at a minimum): specific list of products (using common names) associated with the certificate, location of the final manufacturing, signature of the manufacturer's representative, and a reference to the Domestic Preference statute. If items are purchased via a Supplier, distributor, vendor, etc. from the Manufacturer directly, then the Supplier, distributor, vendor, etc. will be responsible for obtaining and providing these certifications to the parties purchasing the products.

52.i Minor Components - Components within an iron and/or steel product otherwise compliant with the Domestic Preference requirements. This waiver, typically used by Manufacturers, allows use of non-domestically produced miscellaneous Minor Components comprising up to five percent of the total material cost of an otherwise domestically produced iron and steel product. However, unless a separate waiver for a product has been approved, all other iron and steel components in said product must still meet the Domestic Preference requirements. This waiver does not exempt the whole product from the Domestic Preference requirements only Minor Components within said product and the iron or steel components of the product must be produced domestically.

52.j Primarily Iron or Steel - A product is made of greater than 50 percent iron or Steel on a materials cost basis.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

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

B. *Evidence of Contractor's Insurance:* When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out

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(redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

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

2.02 *Copies of Documents*

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

A. Owner shall furnish to Contractor 5 printed copies of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

No supplementary Conditions in this Article

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

SC-4.01 Delete paragraph 4.01.A in its entirety and insert the following new paragraph in its place:

A. The Contract Times will commence on the day indicated in the Notice to Proceed. The Notice to Proceed date must be no later than 30 days after the Effective Date of the Contract. The Owner must issue a Notice to Proceed.

4.05 *Delays in Contractor's Progress*

SC-4.05 Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*

a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled. Extreme unusual weather that is typical for a given region, elevation, or season should not be considered abnormal weather conditions. Requests for time extensions due to abnormal weather conditions will be submitted to the Engineer within five days of the end of the abnormal weather conditions event. It is the responsibility of the Contractor to provide the information listed in SC 4.05.C.5.b.

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b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:

1) Every workday on which one or more of the following conditions exist will be considered a "bad weather day":

i) Total precipitation (as rain equivalent) occurring between 7:00 p.m. on the preceding day (regardless of whether such preceding day is a workday) through 7:00 p.m. on the workday in question equals or exceeds one inch of precipitation (as rain equivalent, based on the snow/rain conversion indicated in the table entitled Foreseeable Bad Weather Days; such table is hereby incorporated in this SC-4.05.C by reference.

ii) Ambient outdoor air temperature at 11:00 a.m. is equal to or less than the following low temperature threshold: -10 degrees Fahrenheit; or, at 3:00 p.m. the ambient outdoor temperature is equal to or greater than the following high temperature threshold: 110 degrees Fahrenheit.

2) Determination of actual bad weather days during performance of the Work will be based on the weather records measured and recorded by Grand Junction Regional Airport (KGJT) weather monitoring station at Lat: 39.13389°N, Lon: 108.53861°W.

3) Contractor shall anticipate the number of foreseeable bad weather days per month indicated in the table in Exhibit A—Foreseeable Bad Weather Days.

4) In each month, every bad weather day exceeding the number of foreseeable bad weather days established in the table in Exhibit A—Foreseeable Bad Weather Days will be considered as "abnormal weather conditions." The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor's then-current Progress Schedule's critical path for the Project.

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

5.02 *Use of Site and Other Areas*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.02.A.2:

3. The proposed work will take place within multiple easements with restrictions that will vary by individual property. The Contractor shall ensure all crew are aware of these restrictions and that all requirements of these restrictions are followed. These requirements are summarized in the 400 Sheets of the Drawings.

5.03 *Subsurface and Physical Conditions*

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

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Geotech Investigation	August 9, 2024	Subsurface investigation results
Subsurface Utility Locations	May 2025	Existing utility data
Groundwater Investigation	N/A	Piezometer results and photos from investigation

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

Drawings Title	Date of Drawings	Technical Data
No drawings available		

5.06 *Hazardous Environmental Conditions*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
No reports available		

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
No drawings available		

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

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

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

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

6.03 *Contractor's Insurance*

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

D. *Other Additional Insureds:* As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following:

1. Town of Palisade,
2. Clifton Sanitation District,
3. J-U-B Engineers, Inc.
4. Grand Valley Irrigation Company
5. Mary Lou Palmer, 640 35 1/2 Rd, Palisade, CO 81526
6. Jennifer Taylor, 3527 Grand Valley Canal Road, Palisade, CO 81526
7. Young Family Trust, 3415 G Road, Clifton, CO 81526
8. John Peterman, 653 36 1/4 Road, Palisade, CO 81526

E. *Workers' Compensation and Employer's Liability:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers' Compensation Act, Jones Act, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	**Policy limits of not less than:**
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
Jones Act (if applicable)	
Bodily injury by accident—each accident	$N/A
Bodily injury by disease—aggregate	$N/A
Employer's Liability	
Each accident	$1,000,000
Each employee	$1,000,000
Policy limit	$1,000,000
Stop-gap Liability Coverage	
For work performed in monopolistic states, stop-gap liability coverage must be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	$N/A

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F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
2. damages insured by reasonably available personal injury liability coverage, and
3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.
    a. Such insurance must be maintained for three years after final payment.
    b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
4. Underground, explosion, and collapse coverage.
5. Personal injury coverage.
6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.

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5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).

6. Any limitation or exclusion based on the nature of Contractor's work.

7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	$2,000,000
Products—Completed Operations Aggregate	$2,000,000
Personal and Advertising Injury	$1,000,000
Bodily Injury and Property Damage—Each Occurrence	$1,000,000

J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	$1,000,000
Each Accident	$1,000,000
Property Damage	
Each Accident	$1,000,000
[or]	
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	$1,000,000

K. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	$N/A
General Aggregate	$5,000,000

L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer's liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage

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as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of $10,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.

M. *Contractor's Pollution Liability Insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than three years after final completion.

Contractor's Pollution Liability	**Policy limits of not less than:**
Each Occurrence/Claim	$N/A
General Aggregate	$N/A

N. *Contractor's Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor's Professional Liability	**Policy limits of not less than:**
Each Claim	$N/A
Annual Aggregate	$N/A

O. *Railroad Protective Liability Insurance:* Prior to commencing any Work within 50 feet of railroad-owned and controlled property, Contractor shall (1) endorse its commercial general liability policy with ISO CG 24 17, removing the contractual liability exclusion for work within 50 feet of a railroad, (2) purchase and maintain railroad protective liability insurance meeting the following requirements, (3) furnish a copy of the endorsement to Owner, and (4) submit a copy of the railroad protective policy and other railroad-required documentation to the railroad, and notify Owner of such submittal.

Railroad Protective Liability Insurance	**Policy limits of not less than:**
Each Claim	$N/A
Aggregate	$N/A

P. *Unmanned Aerial Vehicle Liability Insurance:* If Contractor uses unmanned aerial vehicles (UAV—commonly *referred* to as drones) at the Site or in support of any aspect of the Work, Contractor shall obtain UAV liability insurance in the amounts stated; name Owner, Engineer, and all individuals and entities identified in the Supplementary Conditions as additional insureds; and provide a certificate to Owner confirming Contractor's compliance with this

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requirement. Such insurance will provide coverage for property damage, bodily injury or death, and invasion of privacy.

Unmanned Aerial Vehicle Liability Insurance	Policy limits of not less than:
Each Claim	$N/A
General Aggregate	$N/A

Q. *Other Required Insurance:* None

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).

    a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.

    b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.

2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

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

4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the

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premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of $500,000.

5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit will be a minimum of $500,000.

6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.

7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.

8. include performance/hot testing and start-up, if applicable.

9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.

10 include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds." In addition to Owner, Contractor, and Subcontractors of every tier, include as insureds the following:

    a. Clifton Sanitation District,

    b. Grand Valley Irrigation Company

11. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:

    a. None

12. If debris removal in connection with repair or replacement of insured property is subject to a coverage sublimit, such sublimit will be a minimum of $500,000.

13. In addition to the coverage sublimits stated above, the following coverages are also subject to sublimits, as follows:

    a. None

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provision:

G. *Coverage for Completion Delays:* The builder's risk policy will include, for the benefit of Owner, loss of revenue and soft cost coverage for losses arising from delays in completion that result from covered physical losses or damage. Such coverage will include, without limitation, fixed expenses and debt service for a minimum of 12 months with a maximum deductible of 30 days, compensation for loss of net revenues, rental costs, and attorneys' fees and engineering or other consultants' fees, if not otherwise covered.

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

H. *Builder's Risk and Other Property Insurance Deductibles:* The purchaser of any required builder's risk, installation floater, or other property insurance will be responsible for costs not covered because of the application of a policy deductible.

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1. The builder's risk policy (or if applicable the installation floater) will be subject to a deductible amount of no more than $5,000 for direct physical loss in any one occurrence.

SC-6.04 Delete Paragraph 6.04.A of the General Conditions and substitute the following in its place:

A. *Installation Floater*

1. Contractor shall provide and maintain installation floater insurance on a broad form or "all risk" policy providing coverage for materials, supplies, machinery, fixtures, and equipment that will be incorporated into the Work ("Covered Property"). Coverage under the Contractor's installation floater will include loss from covered "all risk" causes (perils) to Covered Property:

    a. of the Contractor, and Covered Property of others that is in Contractor's care, custody, and control;

    b. while in transit to the Site, including while at temporary storage sites;

    c. while at the Site awaiting and during installation, erection, and testing;

    d. continuing at least until the installation or erection of the Covered Property is completed, and the Work into which it is incorporated is accepted by Owner.

2. The installation floater coverage cannot be contingent on an external cause or risk, or limited to property for which the Contractor is legally liable.

3. The installation floater coverage will be in an amount sufficient to protect Contractor's interest in the Covered Property. The Contractor will be solely responsible for any deductible carried under this coverage.

4. This policy will include a waiver of subrogation applicable to Owner, Contractor, Engineer, all Subcontractors, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.03 *Labor; Working Hours*

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

1. Regular working hours will be 8:00 A.M. to 5:00 P.M.

2. Owner's legal holidays are New Years Day, Martin Luther King Day, President's Day, Memorial Day, Juneteenth Day of Observance, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, Friday Following Thanksgiving Day, Christmas Day, Day After Christmas.

3. Contractor shall review Drawings for property specific working requirements and ensure those conditions are met. Property specific working requirements overrule regular working hour requirements.

7.04 *Services, Materials, and Equipment*

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SC-7.04 Add the following new paragraph immediately after Paragraph SC-7.04.C:

D. All products must meet Domestic Preference requirements.

E. For projects utilizing a De Minimis waiver, Contractor shall maintain an itemized list of non-domestically produced components and ensure that the cost is less than 5% of total project cost for project up to a maximum of $1,000,000.

7.05 *"Or Equals"*

SC-7.05.A Amend the third sentence of paragraph by striking out the following words:

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

SC-7.05.A.1.a.3 Amend the last sentence of Paragraph a.3 by striking out "and;" and adding a period at the end of Paragraph a.3.

SC-7.05.A.1.a.4 Delete paragraph in its entirety and insert "Deleted."

SC-7.05.B Add the following at the end of paragraph

Contractor shall include a Manufacturer's Certification or waiver for compliance with Domestic Preference requirements and supporting data, as applicable. Refer to Sample Language for Manufacturer's Certification provided in these Contract Documents.

7.06 *Substitutes*

SC-7.06.A.3.a.2 Remove "and" from the end of paragraph.

SC-7.06.A.3.a.3 Add "; and" to the end of paragraph.

SC-7.06.A.3.a.4 Add the following new paragraph immediately after Paragraph 7.06.A.3.a.3.

4. Comply with Domestic Preference requirements by providing Manufacturer's Certification or waiver, as applicable. Refer to Sample Language for Manufacturers' Certification provided in these Contract Documents.

7.07 *Concerning Subcontractors and Suppliers*

SC-7.07.B Delete paragraph in its entirety and insert "Deleted".

SC-7.07.E Delete the second sentence of paragraph and insert the following in its place:

Owner may not require that Contractor use a specific replacement.

7.10 *Taxes*

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

A. The Owner is exempt from Colorado state sales and use taxes on materials and equipment that are to be permanently incorporated into the Work (Exemption No. 09803910).

1. The Owner will furnish the required certificates of tax exemption to the Contractor for use in purchasing such supplies and materials.

2. This exemption does not apply to construction tools, machinery, equipment, or other property purchased or leased by the Contractor, or to supplies and materials not permanently incorporated into the Work.

7.12 *Record Documents*

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SC-7.12.A Amend paragraph by adding the following after "written interpretations and clarifications,":

Manufacturer's Certifications,

7.16 *Submittals*

SC-7.16.A.1.c Amend paragraph by deleting the last period and adding:

, including Manufacturer's Certification, or waiver for any item in the submittal subject to Domestic Preference requirements. Refer to the Sample Language for Manufacturers' Certification provided in these Contract Documents.

SC-7.16.C.9 Add new paragraph immediately after Paragraph 7.16.C.8:

9. Engineer's review and approval of a Shop Drawing or Sample shall include review of Manufacturers' Certifications and any waivers in order to document compliance with Domestic Preference requirements, as applicable.

7.17 *Contractor's General Warranty and Guarantee*

SC-7.17.F Add new paragraph immediately after Paragraph 7.17.E:

F. Contractor shall certify prior to final payment that all Work and Materials have complied with Domestic Preference requirements. Contractor shall provide Certification to Owner and Engineer. Refer to the Sample Language for Contractor's Certification provided in these Contract Documents.

ARTICLE 8—OTHER WORK AT THE SITE

No supplementary conditions in this article.

ARTICLE 9—OWNER'S RESPONSIBILITIES

No supplementary conditions in this article.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

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

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

1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.

2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.

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3. *Liaison*

    a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

    b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.

    c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.

4. *Review of Work; Defective Work*

    a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.

    b. Observe whether any Work in place appears to be defective.

    c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.

5. *Inspections and Tests*

    a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.

    b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.

6. *Payment Requests:* Review Applications for Payment with Contractor.

7. *Completion*

    a. Participate in Engineer's visits regarding Substantial Completion.

    b. Assist in the preparation of a punch list of items to be completed or corrected.

    c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.

    d. Observe whether items on the final punch list have been completed or corrected.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.

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5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Authorize Owner to occupy the Project in whole or in part.

SC-10.09 Add new paragraph immediately after Paragraph 10.08:

10.09 *American Iron & Steel*

A. Services required to determine and certify that to the best of the Engineer's knowledge and belief all iron and steel products referenced in engineering analysis, the Plans, Specifications, Bidding Documents, and associated Bid Addenda requiring design revisions are either produced in the United States or are the subject of an approved waiver and services required to determine to the best of the engineer's knowledge and belief that approved substitutes, equals, and all iron and steel products proposed in the shop drawings, Change Orders and Partial Payment Estimates are either produced in the United States or are the subject of an approved waiver under Section 746 of Title VII of the Consolidated Appropriations Act of 2017 (Division A - Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2017).

ARTICLE 11—CHANGES TO THE CONTRACT

11.02 *Change Orders*

SC-11.02.C Add new paragraph immediately after Paragraph 11.02.B:

C. The Engineer or Owner shall contact the Agency for concurrence on each Change Order prior to issuance. All Contract Change Orders must be concurred on (signed) by Agency before they are effective.

11.03 *Work Change Directive*

SC-11.03.A.2 Add new Paragraph 11.03.A.2 immediately after Paragraph 11.03.A, which shall be renamed Paragraph 11.03.A.1:

2. The Engineer or Owner shall contact the Agency for concurrence on each Work Change Directive prior to issuance. Once authorized by Owner, a copy of each Work Change Directive shall be provided by Engineer to the Agency.

11.05 *Owner-Authorized Changes in the Work*

SC-11.05.B Add the following at the end of this paragraph:

For Owner-authorized changes in the Work, the Contractor will provide the Manufacturer's Certification, or waiver, for materials subject to Domestic Preference requirements except when sole-source is specified, in which case the Engineer will provide the Manufacturer's Certification, or waiver

11.09 *Change Proposals*

SC-11.09.B.2.c Add new paragraph immediately after Paragraph 11.09.B.2.b:

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c. For change orders involving materials subject to Domestic Preference requirements, Contractor shall include a Manufacturer's Certification or waiver, as applicable. Refer to the Sample Language for Manufacturer's Certification provided in these Contract Documents

ARTICLE 12—CLAIMS

No suggested Supplementary Conditions in this Article.

ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

13.01 *Cost of the Work*

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

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

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

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

13.02 *Allowances*

SC-13.02.C Delete paragraph in its entirety and insert "Deleted".

13.03 *Unit Price Work*

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the extended price of a particular item of Unit Price Work amounts to 5 percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

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ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCCEPTANCE OF DEFECTIVE WORK

14.03 *Defective Work*

SC 14.03.G Add new paragraph immediately after Paragraph 14.03.F:

G. Installation of materials that are non-compliant with Domestic Preference requirements shall be considered defective work. Contractor should ensure that Engineer has an approved Manufacturer's Certification, or waiver, prior to any domestic preference compliant item being delivered to the project site.

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

15.01 *Progress Payments*

SC-15.01.B.4 Add the following language at the end of paragraph:

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

SC-15.01.B.5 Add new paragraph immediately after Paragraph 15.01.B.4:

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

SC-15.01.B.6 Add new paragraph immediately after Paragraph 15.01.B.5:

6. By submitting an Application for Payment, based in whole or in part on furnishing equipment or materials, Contractor certifies that such equipment and materials are compliant with Domestic Preference requirements. Manufacturer's Certification for material(s) satisfy these requirements. Refer to the Sample Language for Manufacturer's Certification provided in these Contract Documents.

SC-15.01.C.2.d Add new paragraph immediately after Paragraph 15.01.C.2.c:

d. The materials presented for payment in an Application for Payment comply with Domestic Preference requirements.

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

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

15.02 *Contractor's Warranty of Title*

SC 15.02.A Amend paragraph by striking out the following text: "7 days after".

15.03 *Substantial Completion*

SC 15.03.A Modify by adding the following after the last sentence:

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Contractor shall also submit the Contractor's Certification of Compliance certifying that to the best of the Contractor's knowledge and belief all Iron and Steel products, Manufactured Products, and Construction Materials proposed in the Shop Drawings, Change Orders, and Partial Payment Estimates, and those installed for the Project, comply with Domestic Preference requirements.

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

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No suggested Supplementary Conditions in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

17.02 *Arbitration*

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

17.02 *Arbitration*

A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules (subject to the conditions and limitations of this Paragraph SC-17.02). Any controversy or claim in the amount of $100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations.

C. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.

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D. The Arbitrators will have the authority to allocate the costs of the arbitration process among the parties, but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.

E. The award of the arbitrators must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.

F. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.

G. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration;

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration, and which will arise in such proceedings;

3. such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and

4. the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.

H. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.

I. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

17.03 *Attorneys' Fees*

SC-17.03 Add the following new paragraph immediately after Paragraph 17.02. [Note: If there is no Paragraph 17.02, because neither arbitration nor any other dispute resolution process has been specified here in the Supplementary Conditions, then revise this to state "Add the following new Paragraph immediately after Paragraph 17.01" and revise the numbering accordingly].

17.03 *Attorneys' Fees*

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

ARTICLE 18—MISCELLANEOUS

SC-18.11 Add new paragraph immediately after Paragraph 18.10:

18.11 *Tribal Sovereignty*

A. No provision of this Agreement will be construed by any of the signatories as abridging or debilitating any sovereign powers of the Southern Ute Tribe, the Ute Mountain Tribe, or the Ute Indian Tribe of the Unita and Ouray Reservation; affecting the trust-beneficiary relationship between the Secretary of the Interior, Tribe, and Indian landowner(s); or interfering with the government-to-government relationship between the United States and the Tribe

SC-19 – Add the following new Article 19 immediately after Article 18:

ARTICLE 19—FEDERAL REQUIREMENTS

19.01 *Agency Not a Party*

A. This Contract is expected to be funded in part with funds provided by Agency. Neither Agency, nor any of its departments, entities, or employees, is a party to this Contract.

19.02 *Contract Approval*

A. Owner and Contractor will furnish Owner's attorney such evidence as required so that Owner's attorney can complete and execute the "Certificate of Owner's Attorney" before Owner submits the executed Contract Documents to Agency for approval. Refer to Certificate of Owner's Attorney and Agency Concurrence provided in these Contract Documents.

B. Agency concurrence is required on both the Bid and the Contract before the Contract is effective.

19.03 *Conflict of Interest*

A. Contractor may not knowingly contract with a Supplier or Manufacturer if the individual or entity who prepared the Drawings and Specifications has a corporate or financial affiliation with the Supplier or Manufacturer. Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest or other interest in or a tangible personal benefit from the Contractor. Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Contractor or subcontractors.

19.04 *Gratuities*

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A. If Owner finds after a notice and hearing that Contractor, or any of Contractor's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Owner or Agency in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, Owner may, by written notice to Contractor, terminate this Contract. Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which Owner bases such findings shall be an issue and may be reviewed in proceedings under the dispute resolution provisions of this Contract.

B. In the event this Contract is terminated as provided in paragraph 19.04.A, Owner may pursue the same remedies against Contractor as it could pursue in the event of a breach of this Contract by Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, Owner may pursue exemplary damages in an amount (as determined by Owner) which shall not be less than three nor more than ten times the costs Contractor incurs in providing any such gratuities to any such officer or employee.

19.05 *Small, Minority and Women's Businesses*

A. If Contractor intends to let any subcontracts for a portion of the work, Contractor will take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible. Affirmative steps will include:

1. Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

2. Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;

3. Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;

4. Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises;

5. Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.

19.06 *Anti-Kickback*

A. Contractor shall comply with the Copeland Anti-Kickback Act (40 USC 3145) as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans or Grants of the United States"). The Act provides that Contractor or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public facilities, to give up any part of the compensation to which they are otherwise entitled. Owner shall report all suspected or reported violations to Agency.

19.07 *Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended*

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A. Contractor to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

19.08 *Equal Employment Opportunity*

A. The Contract is considered a federally assisted construction contract. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of "federally assisted construction contract" in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, "Equal Employment Opportunity" (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and implementing regulations at 41 CFR part 60, "Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor."

19.09 *Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)*

A. Contractors that apply or bid for an award exceeding $100,000 must file the required certification (RD Instruction 1940-Q Exhibit A-1). The Contractor certifies to the Owner and every subcontractor certifies to the Contractor that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining the Contract if it is covered by 31 U.S.C. 1352. The Contractor and every subcontractor must also disclose any lobbying with non-federal funds that takes place in connection with obtaining any federal award. Such disclosures are forwarded from tier to tier up to the Owner. Necessary certification and disclosure forms shall be provided by Owner.

19.10 *Environmental Requirements*

A. When constructing a Project involving trenching and/or other related earth excavations, Contractor shall comply with the following environmental conditions:

1. Wetlands – When disposing of excess, spoil, or other Construction Materials on public or private property, Contractor shall not fill in or otherwise convert wetlands.

2. Floodplains – When disposing of excess, spoil, or other Construction Materials on public or private property, Contractor shall not fill in or otherwise convert 100-year floodplain areas (Standard Flood Hazard Area) delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, e.g., alluvial soils on NRCS Soil Survey Maps.

3. Historic Preservation - Applicants shall ensure that Contractors maintain a copy of the following inadvertent discovery plan onsite for review:

a. If during the course of any ground disturbance related to any Project, any post review discovery, including but not limited to, any artifacts, foundations, or other indications of past human occupation of the area are uncovered, shall be protected by complying with 36 CFR § 800.13(b)(3) and (c) and shall include the following:

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i. All Work, including vehicular traffic, shall immediately stop within a 50 ft. radius around the area of discovery. The Contractor shall ensure barriers are established to protect the area of discovery and notify the Engineer to contact the appropriate RD personnel. The Engineer shall engage a Secretary of the Interior (SOI) qualified professional archeologist to quickly assess the nature and scope of the discovery; implement interim measures to protect the discovery from looting and vandalism; and establish broader barriers if further historic and/or precontact properties, can reasonably be expected to occur.

ii. The RD personnel shall notify the appropriate RD environmental staff member, the Federal Preservation Officer (FPO), and State Historic Preservation Office (SHPO) immediately. Indian tribe(s) or Native Hawaiian Organization (NHOs) that have an interest in the area of discovery shall be contacted immediately. The SHPO may require additional tribes or NHOs who may have an interest in the area of discovery also be contacted. The notification shall include an assessment of the discovery provided by the SOI qualified professional archeologist.

iii. When the discovery contains burial sites or human remains, the Contractor shall immediately notify the appropriate RD personnel who will contact the RD environmental staff member, FPO, and the SHPO. The relevant law enforcement authorities shall be immediately contacted by onsite personnel to reduce delay times, in accordance with tribal, state, or local laws including 36 CFR Part 800.13; 43 CFR Part 10, Subpart B; and the Advisory Council on Historic Preservation's Policy Statement Regarding treatment of Burial Sites, Human Remains, or Funerary Objects (February 23, 2007).

iv. When the discovery contains burial sites or human remains, all construction activities, including vehicular traffic shall stop within a 100 ft. radius of the discovery and barriers shall be established. The evaluation of human remains shall be conducted at the site of discovery by a SOI qualified professional. Remains that have been removed from their primary context and where that context may be in question may be retained in a secure location, pending further decisions on treatment and disposition. RD may expand this radius based on the SOI professional's assessment of the discovery and establish broader barriers if further subsurface burial sites, or human remains can reasonably be expected to occur. RD, in consultation with the SHPO and interested tribes or NHOs, shall develop a plan for the treatment of native human remains.

v. Work may continue in other areas of the undertaking where no historic properties, burial sites, or human remains are present. If the inadvertent discovery appears to be a consequence of illegal activity such as looting, the onsite personnel shall contact the appropriate legal authorities immediately if the landowner has not already done so.

vi. Work may not resume in the area of the discovery until a notice to proceed has been issued by RD. RD shall not issue the notice to proceed until it has

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determined that the appropriate local protocols and consulting parties have been consulted.

vii. Inadvertent discoveries on federal and tribal land shall follow the processes required by the federal or tribal entity.

4. Endangered Species – Contractor shall comply with the Endangered Species Act, which provides for the protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Contractor, Contractor will immediately report this evidence to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the U.S. Fish and Wildlife Service.

5. Mitigation Measures – The following environmental mitigation measures are required on this Project: [Insert mitigation measures from the Letter of Conditions here].

19.11 *Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708)*

A. Where applicable, for contracts awarded by the Owner in excess of $100,000 that involve the employment of mechanics or laborers, the Contractor will comply with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, the Contractor will compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic will be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

19.12 *Debarment and Suspension (Executive Orders 12549 and 12689)*

A. A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

19.13 *Procurement of recovered materials*

A. The Contractor will comply with 2 CFR Part 200.322, "Procurement of recovered materials."

19.14 *Domestic Preference*

A. Build America, Buy America Act (BABAA). All Iron and Steel Products, Manufactured Products, and Construction Materials used in this project must comply with the Build America, Buy America Act (BABAA) requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953. Aggregates such as stone, sand, or gravel do not apply to BABAA.

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B. The following waivers apply to this Contract:

1. BABAA De Minimis, Small Grants and Minor Components

19.15 *Telecommunications and Video Surveillance Services or Equipment Prohibitions*

A. The telecommunication and video surveillance services and equipment prohibitions under 2 CFR 200.216 apply to this contract. This contract may not be used to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. Covered telecommunications equipment is:

1. Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

2. Video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

3. Telecommunications or video surveillance services provided by such entities or using such equipment.

4. Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

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EXHIBIT A—FORESEEABLE BAD WEATHER DAYS

Month	Number of Foreseeable Bad Weather Days in Month Based on Precipitation as Rain Equivalent (inches) (1)	Ambient Outdoor Air Temperature (degrees F)	
		Number of Foreseeable Bad Weather Days in Month Based on Low Temperature (at 11:00 a.m.)	Number of Foreseeable Bad Weather Days in Month Based on High Temperature (at 3:00 p.m.)
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	0	0	0
July	0	0	0
August	0	0	0
September	0	0	0
October	0	0	0
November	0	0	0
December	0	0	0

Notes:

1. Two inches of sleet equal one inch of rain. Five inches of wet, heavy snow equal one inch of rain. Fifteen inches of “dry” powder snow equals one inch of rain.

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WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]

Owner:	Town of Palisade	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	81-23-029
Contractor:		Contractor's Project No.:	
Project:	Sewer Transfer 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:		

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CHANGE ORDER NO.: [Number of Change Order]

Owner:	Town of Palisade	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	81-23-029
Contractor:		Contractor's Project No.:	
Project:	Sewer Transfer 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: $ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: $ _____	**[Increase] [Decrease]** from previously approved Change Orders No.1 to No. **[Number of previous Change Order]**: Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: $ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: $ _____	**[Increase] [Decrease]** this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: $ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

	Recommended by Engineer (if required)	Authorized by Owner
By:	_____	_____
Title:	_____	_____
Date:	_____	_____

	Authorized by Owner	Approved by Funding Agency (if applicable)
By:	_____	_____
Title:	_____	_____
Date:	_____	_____

EJCDC® C-941, Change Order.
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FIELD ORDER NO.: [Number of Field Order]

Owner:	Town of Palisade	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	81-23-029
Contractor:		Contractor's Project No.:	
Project:	Sewer Transfer 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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TECHNICAL SECTION 1: GENERAL REQUIREMENTS

FOR

Town of Palisade, Colorado
Sewer Transfer Line

December 2025

Prepared by: J-U-B Engineers, Inc.
81-23-029

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TECHNICAL SPECIFICATIONS
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TECHNICAL SECTION 3 SITEWORK (LIFT STATION 127+05 TO 127+90)

TECHNICAL SECTION 4 SITEWORK (LAGOON ABANDONMENT)

END OF SECTION

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SECTION 01100

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Contract description.

B. Contractor's use of site.

C. Work sequence.

D. Coordination

1.2 CONTRACT DESCRIPTION

A. This contract is for the Town of Palisade – Sewer Transfer Line.

B. Includes the installation of approximately 5 miles of 8” and 18” sanitary sewer pipe, sewer lift station, and related appurtenances between the existing Town of Palisade Lagoons and Clifton Sanitation District wastewater system.

C. Timing – Completion of project is requested to occur as soon as possible. Proposed schedule is included with Invitation for Bid.

D. Perform Work of this Contract under a unit price contract with Owner in accordance with Conditions of Contract.

1.3 CONTRACTOR'S USE OF SITE

A. Limit use of site:
   1. Contractor shall maintain access to residences at all times.

B. Construction Operations: Limited to construction and staging areas noted on Drawings
   1. Contractor shall conduct all operations in accordance with all Federal, State and local regulations.
   2. Contractor is responsible for knowing and conducting work in accordance with all laws and regulations (OSHA, etc).
   3. Contractor shall be solely responsible for securing equipment and materials stored in staging areas.
   4. The Contractor shall not stage equipment or materials on private property without written consent from the owner. Written consent documents shall be provided to the engineering prior to use of private property.

C. Ground Disturbances:
   1. Ground disturbances shall be limited to only those areas necessary to safely implement the project.

D. Wetlands/Environmental Restrictions

1. General Requirements
   a. To avoid the yellow-billed cuckoo nesting season, no work shall occur within the portion of the Project that overlaps U.S. Fish and Wildlife Service Designated Critical Habitat between April 1st to July 15th. This area includes STA 207+00 to 211+00 and 235+00 to 273+00.
   b. Equipment would be cleaned prior to arrival at the site to avoid noxious weed dispersal within or near the Project Area.
   c. An approved native seed mix appropriate to the Project Areas would be applied post construction, where applicable, to areas where ground disturbance has occurred.
   d. An approved spill prevention, control, and countermeasure (SPCC) plan would be in place prior to any construction activities.
   e. All construction equipment shall be decontaminated with high pressure water prior to mobilization to the job site to remove all surface oil, grease, dirt, and plant matter. Proper decontamination is particularly critical to prevent the spread of noxious and/or non-native vegetation into agricultural fields.
   f. Machinery will be fueled or lubricated no less than 150 feet from live water. Machinery will be fueled over a surface that will facilitate spill remediation. Machinery shall be maintained in a petroleum leak-free condition to avoid and reduce potential for groundwater contamination.
   g. Major maintenance of equipment such as changing fluids, overhaul, tune-ups, and similar types of regularly scheduled maintenance shall be performed at an approved off-site facility or staging area.
   h. Petroleum products and hazardous, toxic, and/or deleterious materials shall not be stored, disposed of, or accumulated adjacent to or in the immediate vicinity of live water.
   i. Portable toilets shall not be placed adjacent to canals, streams, lakes, wetlands, wells, or springs. They shall be located no less than 150 feet from these areas to prevent contamination of any water sources.
2. Wetland
   a. Areas labeled as wetlands on Project Drawings are subject to special requirements.
      1) The top 6 to 12 inches of the trench should normally be backfilled with topsoil from the trench.
      2) Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

E. Time Restrictions for Performing Work can be found in SC-7.03.

F. Separate lift station technical specifications provided in Division 3 shall be used for Work between Sta. 127+05 and Sta. 127+90. For Work outside these stations, use technical specifications provided in Division 2 and Division 4.

1.4 WORK SEQUENCE

A. Construct Work in a manner to meet the requirements of these specifications

B. Submit a proposed work sequence plan with schedule at preconstruction meeting for approval. Contractor's plan may differ from the suggested work sequence plan if the Contractor has different solutions than those suggested.

C. Proposed Work sequence should include the sequence of work that will be performed including:
   1. Site Preparation
   2. Removal of asphalt surface
   3. Installation of proposed concrete pavement and subgrade

D. Timing Restrictions
   1. To avoid the yellow-billed cuckoo nesting season, no work shall occur within the portion of the Project that overlaps U.S. Fish and Wildlife Service Designated Critical Habitat between April 1st to July 15th without an approved nesting survey. This area includes STA 207+00 to 211+00 and 235+00 to 273+00.
   2. Excavation activities and subsurface work along the GVIC canal must take place while the canal is fully drained of water. The dates for this period will vary from year to year but will start no later than November 20th of each year, while excavation activities must cease no later than March 15th of each year. All construction equipment and materials must be removed from canal bed prior to March 15th of each year.
   3. Surface work adjacent to the canal (such as removal of existing structures, fences, or other improvements, including trees or vegetation) may occur any time of year, as long as there is no interference with agricultural or irrigation activities. Any surface work, including clearing, grubbing, improvement removal and replacement, access road construction, pipe leakage testing, and tail ditch removal during the irrigation season shall not penetrate deeper than two feet (2'), but in the case of gate post footer installation three feet (3') below the original surface grade.
   4. Work on the lift station may occur any time of year as long as there is no dewatering discharge into the GVIC canal while it is operating. An alternative dewatering plan as developed by the Contractor according to their means and methods would be allowed provided it conforms to the COG08000 General Permit.

1.5 COORDINATION

A. General Project
   1. Owner shall be responsible for coordinating start and stop of contract period
   2. Contractor shall provide timely update of work sequence and schedule to Owner throughout project
   3. Use of work prior to completion: Owner reserves right to make use of any portion of the work prior to completion of the entire Contract without invalidating the Contract and without constituting acceptance of any of the work, except where Owner's use may damage applied products

B. Property Owners
   1. Contractor: primary responsibility for coordination with property owners.
   2. Property owners shall be notified at least 24 hours prior to any disturbance to their property.
   3. Delays in Contractor's schedule and all costs associated such a delay due to Contractor's failure to notify property owners shall be at Contractor's sole expense.

1.6 ORIGINAL BID QUESTIONS AND ANSWERS

A. This section contains previously received questions in the original Bid, as well as the answers provided in the Bid Addendums. Drawings and Specifications take precedence when conflicting information is encountered.

Question 1.

Q: Where specifically is dewatering water to be discharged when we cannot discharge into the canal?

A: Dewatering discharge locations must be in accordance with COG080000 General Permit.

Question 2.

Q: Where is the expected contractor staging area located?

A: Sections of Riverbend Park may be used for limited staging at the Town's discretion. Additionally, the properties owned by Wilcox (3333 E 3/4 Rd) and Vanlandingham (641 35 1/2 Rd) have expressed openness to staging. This coordination shall be performed by the Contractor post-award.

Question 3.

Q: What are the existing roadway pavement sections to be removed?

A: Our quantity estimations assume 5" of asphalt and 9" of aggregate base course. However, existing sections shall be matched and the actual quantities installed shall be paid for.

Question 4.

Q: Will environmental inspections connected to examining nesting sites be required? If so, who is to provide?

A: The Contractor will be required to provide a qualified biologist for such work. A "Wildlife Biologist" pay item has been added to the project.

Question 5.

Q: Where specifically is concrete encasement of water mains required? How many should be included in pricing?

A: Assume six locations for encasement according to Detail 2 Sheet C-506 (STA 117+62, STA 122+34, STA 198+54, STA 263+33, STA 268+59, STA 282+65).

Question 6.

Q: Please provide clarity on how grape trellises are to be reestablished. Who is to reseed grapes? What is specifically required of the contractor to reestablish grape fields? Please provide specifications.

A: Parcel 294105100103, after removal of the necessary grape plants, the grape trellises shall be removed, salvaged, stockpiled, and replaced after construction in the vicinity (or replaced in-kind if unsalvagable). Reseeding of the grape plants is not the responsibility of the Contractor, as the grape bushes are identified as "to be removed by project" only, and not "replaced by project." For reference, a photo of a portion of the trellis is included below.



Question 7.

Q: Please clarify work required to fill canal belly on C-218? Can the limits of the canal belly modification be shown? Can a detail be provided?

A: Significant ponding during non-irrigation season occurs in this vicinity of the canal (see below winter aerial photograph) and this work seeks to decrease this ponding. Canal inverts at Stations 193+00 and 200+00 shall be surveyed by Contractor, and the low points in the canal shall be filled so that there is a constant grade between these two Stations. Based on our preliminary assumptions, this work involves an estimated quantity of 1,226 CY of fill material based on an assumed area of 0.38 acres and an assumed average depth of fill of 2', but the actual work performed shall be paid for based on unit price per CY.



Question 8.

Q: What is the flow and flow direction of existing sanitary sewer shown on sheets C-225 and C-226?

A: The sewer line shown on sheet C-225 is abandoned, but it previously flowed from restrooms at interior of park out to the east, toward the lagoon headworks. The flow to MH-66 comes from the north and proceeds to the Town of Palisade's lagoons to the southwest.

Question 9.

Q: Has the Owner secured a permit for the work in the designated wetlands?

A: Yes, Nationwide Permit Verification SPA-2025-086 has been obtained from the U.S. Army Corps of Engineers.

Question 10.

Q: Who is responsible for removing and restoring property Owner livestock pens and their appurtenances?

A: In the C-400 Drawings, anything identified as "to be removed and replaced by project" (or similar wording) means it is the responsibility of the Contractor. Anything identified as "to be addressed under relocation" (or similar wording) means it is the responsibility of the property owner. For example, Parcel 294312108005 has six farm gates that the landowner will move as they are "to be addressed under relocation." As another example, Parcel 294312108004, has six corral panels that will be moved by landowner but then put back into place by Contractor.

Question 11.

Q: Who is responsible for removing property Owner junk in the path of installation?

A: In the C-400 Drawings, rubbish and debris (such as tires, wood piles, old equipment, etc.) are identified as to be "Addressed under relocation." This means that the landowner is responsible for removal/relocation of such items prior to construction.

Question 12.

Q: What depth of aggregate replacement on private property should be priced? What material should be priced?

A: 6" depth of material that matches existing.

Question 13.

Q: Some of the existing trees to be replaced are noted as fruit trees. Are the specific species of fruit trees that are required? For example, some are noted as ‘apple tree’. What kind of ‘apple tree’ needs to be replanted?

A: No fruit trees are to be replaced by the Contractor. In the C-400 Drawings, fruit trees are identified as "to be removed by project." This means that the Contractor shall remove these items (if necessary), but does not need to replace them as the landowners have already been compensated for replacement. As noted in the measurement and payment description of item "Property Removals and Restoration", the Contractor's means and methods will dictate the extent necessary for removal, salvage, replacement, and restoration. For example, Contractor may elect to operate in a smaller footprint and not disturb certain fruit trees if unnecessary. This applies to other similar items within the "Property Removals and Restoration" pay item and was intended to reduce the impact on the private property while allowing Contractor flexibility in work space.

Question 14.

Q: Does the Owner or its agents have specific knowledge of any unusual or perhaps unclear restoration items or circumstances that the contractor should specifically be aware of when pricing the bid?

A: Restoration items and circumstances have been identified in the Drawings. The C-400 Drawings contain the unique restoration items/circumstances for each individual private property as agreed upon with the landowners.

Question 15.

Q: What is the approximate height of the overhead high voltage power lines?

A: Overhead power lines were not surveyed for height. This is the responsibility of the Contractor to determine.

Question 16.

Q: Who is responsible for approving wetlands restoration?

A: Contractor shall abide by the reseeding or site restoration requirements and Owner will approve that this work conforms with specifications.

Question 17.

Q: Several locations note ‘remove and replace irrigation system’. Could clarity be provided on these? Are these irrigation services or landscape type sprinkler systems?

A: These are landscape type sprinkler systems.

Question 18.

Q: The Sewer Main is located along the centerline of Road F. Can Road F be fully closed (except for local access)?

A: Mesa County Road and Bridge Department has stated the following: "We are comfortable letting a contractor close F Road for the construction and just keeping it open to local traffic. With the correct plan it is definitely something we would consider and allow."

Question 19.

Q: When is the gas main relocation on 34 Road expected to occur?

A: Xcel has stated that six weeks notice will be needed prior to relocating this gas line.

Question 20.

Q: Can a detail of the guardrail be provided?

A: If Contractor determines that guardrail removal and replacement is required in order to complete the work, match existing.

Question 21.

Q: Relocating the bee hive. Can you indicate what the property owner wants? Is that something I need to hire a beekeeper for or is the property owner a beekeeper and will do it themselves?

A: This item is indicated in the C-400 drawings as "to be addressed under relocation." Items in the C-400 drawings that are identified in this way are not a responsibility of the Contractor and will be performed prior to construction by the landowner or others. Please note that the Property Removals and Restoration measurement and payment description states the following: "Does not include any items designated as to be addressed under relocation, as such items are not part of the Project and are for the Contractor's information only.

Question 22.

Q: Is any documentation required to be submitted with the bid to show compliance with Article 19.05 - Small, Minority and Women's Businesses?

A: No.

Question 23.

Q: Refer to Bid Form for Construction Contract, Article 2 – Attachments to Bid. Please provide the following forms that are shown as required to be submitted with our bid, as they are not included in the specifications: 2.01.B - List of Proposed Subcontractors, 2.01.C - List of Proposed Suppliers, 2.01.H - Manufacturers' Certification letter of compliance

A: It will be up to the Contractor's discretion for providing the list of Proposed Subcontractors and list of Proposed Suppliers. Please see RUS Bulletin 1780-26 Attachment A.3 and A.4 for Certification of Compliance.

Question 24.

Q: Refer to Advertisement for Bid, Instructions to Bidders Paragraph: This paragraph instructs us to provide successfully completed projects similar in nature in a separate sealed envelope. Should the Qualification Statement and its supporting attachments also be provided within this separate envelope, or should the Qualification Statement and its supporting attachments be attached to the rest of our bid response?

A: Any information documenting prior experience and qualifications shall be provided in a separate envelope.

Question 25.

Q: Several Bid Items are not described in 01250-Measurement and Payment. Please confirm if this is done intentionally or if measurement and payment for those items can be found elsewhere.

A: Measurement and payment descriptions are only provided for non-standard items. Measurement for these items will be made based on units described in C-410, and installation requirements are provided throughout the project specifications and CDOT Standards.

Question 26.

Q: Please clarify which specification(s) are to be followed for lift station/pigging station piping and fittings (material, flange, coating, and lining).

A: Technical Section 3: Sitework shall cover this work.

Question 27.

Q: In reference to the 'Table of Contents – Valve Types' in 43 30 00 Hydraulic Process Valves, is the table of contents simply a general listing of valve types or is it a project-specific list? In other words, do ARV-1, ARV-2, etc. correspond directly to ARV-1, 2, etc. on the Drawings?

A: That is correct, not all of the valves listed in section 43 30 00 are necessarily included in the project. Please refer to the drawings for the required valves.

Question 28.

Q: Has any water quality testing been performed on near-surface groundwater (~50' or shallower from the surface) to determine water quality parameters (TDS, Chlorides, sulfates, biologicals, etc.)? a. Does the engineer or municipality have reason to believe that such waters can or cannot be discharged into surface ditches during dewatering provided such water has had sediments removed to or below dischargeable limits? b. In the event contaminated or otherwise non-compliant water, provided such contamination is not the result of sediments created during excavation, is encountered, how will the Owner address this, or should the bidder make allowances for the disposal of such waters?

A: No water quality testing has been performed as part of this project. Dewatering discharge must be in accordance with COG080000 General Permit.

Question 29.

Q: Specifications document notes that water may not discharge to the canal "…when the canal is full." a. Can you provide a clearer definition of "…when the canal is full" as water elevations may vary? b. Wherein discharge to the canal may not occur due to elevation, can you clarify where other discharges may occur such as to municipal ditches, private irrigation ditches or other locations?

A: Canal being full is intended to mean when the canal is in operation. Please see below table showing approximate canal opening/closing dates based on flow measurement data at the Grand Valley Canal diversion (from https://dwr.state.co.us/Tools/Stations). All dewatering dischage shall be in accordance with COG080000.

YEAR	*Last Day Zero Flowrate*	*First Day Zero Flowrate*
2024	*April 2nd*	*November 1st*
2023	*April 8th*	*October 31st*
2022	*March 23rd*	*November 3rd*
2021	*April 3rd*	*November 5th*
2020	*April 5th*	*November 5th*
2019	*March 31st*	*November 5th*
2018	*April 1st*	*November 8th*
2017	*April 3rd*	*November 1st*
2016	*April 4th*	*November 1st*
2015	*March 31st*	*November 2nd*
2014	*April 1st*	*November 1st*

Question 30.

Q: From our review of the project, bypass pumping will only be required for tie-ins at Stations 10+00 and 282+82. a. For each location, can you please provide estimated i. Bypass intercepting location ii. Flow iii. Suction lift (feet) iv. Discharge head (static head) v. Discharge point and distance from pump

A: See attached Clifton Sanitation District Bypass Exhibit and Town of Palisade Bypass Exhibit.

Question 31.

Q: For the access road outlined on Sheets C-211 through C-218 (Stations 123+50 through 198+00), can you confirm that this road will remain as a

permanent road and does not require removal after completion of pipe installation and surface remediation. b. For the access road through Riverbend Park (Sheets C-219 to C-226, Stations 204+00 to 263+00), can you clarify: i. Between station locations, is the access road to follow the GVIC Canal rather than the pipeline route? In certain areas, such as between Stations 223+00 and 231+20, the pipeline does not follow the existing road surface but rather is approximately 50’ or more south of the road. ii. Can you please confirm that the access road and all improvements required for the proposal will remain permanently and not require removal once construction is complete

A: The access road will remain as a permanent road (no removal required). Within Riverbend Park, the access road will follow the GVIC canal rather than the pipeline alignment and the provided estimated quantities for Unclassified Excavation (Canal Road Surface) and Canal Road Surface (9" Thick Class 6 ABC) are based on this.

Question 32.

Q: In the geotechnical report, Boring “B-Lift Station” is shown to a depth of 26.3’ below ground surface (BGS). However, per Detail #1 on S-501, excavation is shown to at least 4649.5’, a depth of 30’ BGS. Can you provide any additional information regarding the anticipated materials and ground conditions that should be expected below the 26.3’ BGS horizon?

A: We anticipate the gravels to extend to 30+ feet. Shale bedrock will be present below the gravels; however, typically the gravels are 20+ feet thick.

Question 33.

Q: Sheet C-512, Detail AA – It can be deduced that the horizontal dimension of the headwall anchor is 9 feet (7’ plus 1’ on each side overlap). However, a total vertical dimension cannot be determined as only a partial vertical dimension (5’) is noted. Can you please provide the intended overall vertical dimension?

A: The intended overall vertical dimension of the concrete headwall anchor is 8'. This can be more clearly seen in Detail 3 Sheet C-512 (along with 2' of structural backfill).

Question 34.

Q: Sheet C-401, Parcel 294312100126 – 2 separate items are noted as “Dirt” (5,900 and 4,808 sq. feet, respectively) with the remarks “To be removed & replaced by the project.” Can you provide additional information and/or clarification, such as total volume of “dirt”, that will allow a better understanding of the mitigation efforts required for these items?

A: On Sheet C-401, Parcel 294312100126, each "dirt" item and quantity represents the square footage of existing dirt surface within the permanent and temporary easement as noted, and would require removal in accordance with Note #2 such that existing conditions are restored upon completion of the work. As noted in the measurement and payment description of item "Property Removals and Restoration", the Contractor's means and methods will dictate the extent necessary for removal, salvage, replacement, and restoration. For example, Contractor may elect to operate in a smaller footprint and not disturb the dirt in the temporary easement (or some portion thereof). This applies to other similar items within the "Property Removals and Restoration" pay item and was intended to reduce the impact on the private property while allowing the Contractor flexibility in work space.

Question 35.

Q: Are injectables such as acrylite, polyurethane or cementitious grouts acceptable for use in the subsurface for water and/or ground control?

A: Such technologies shall be permitted for construction of the lift station and must be certified to NSF 61. If applied for soil stabilization for the lift station excavation, there must be a sealed engineering plan supporting the use of these technologies.

Question 36.

Q: Sheet C-506, Detail 1 depicts “Typical Trench Detail.” Within the parameters of this job and using the detail provided, this equates to a maximum trench width of 3 feet (36”) for the 18” gravity main and 39” for the short portion of 21” gravity main. While such dimensions are possible on shallow, unshored sections, deeper, shored portions of the pipelines demand larger dimensions to accommodate shoring boxes and equipment.

a. Can you provide clarification on anticipated trench width, inclusive of shoring equipment dimensions, throughout the pipeline route and with respect to depth?

b. In regards to the pay items affected by trench width, such as backfill, haunching materials, and granular stabilization materials, can you provide clarification as whether or not the quantities on the Basis of Bid reflect anticipated trench widths?

A: The width indicated in the "Typical Trench Detail" can be disregarded where shoring is required. Our estimated quantities are conservative and assume a 6' trench width (edge to edge, in which space shoring equipment must fit) for gravity sewer sections (even where it is shallow) and 4' trench width for force main. Asphalt-related quantities are also estimated based off these trench widths and in accordance with the pavement replacement details shown in Detail 1 Sheet C-506.

Question 37.

Q: Certain notes, such as the one on Sheet C-205 where the pipeline crosses 33 ¾ Road, note a trench width of 6’.

a. Is the noted “6 foot width” measured from edge of trench to edge of trench with a 12” offset to edge of pavement on either side? Or is this measured from edge of pavement to edge of pavement? With the depth of the gravity line nearly 15’ below existing grade, a minimum of 6’ width as measured from edge of trench to edge of trench will be required to accommodate shoring equipment. Can you provide clarity regarding this, and other similar situations along the pipeline route?

b. In regard to MH-14 on Sheet C-205, as well as similar other manholes located along the route, a 6’ wide trench will not facilitate our needs for installation of a 60” diameter precast manhole. Shoring will require an excavation of approximately 10’ x 10’, far exceeding the noted 6’ width. Can you please clarify anticipated excavation limits for this and similar manhole structures?

c. In reference to Items (a) and (b) above, can you provide revision or clarification to the affected bid items or provide guidance to the bidder as how to proceed with such variances to the plan?

A: Yes, the noted 6' trench width (or 4' where noted) is edge of trench to edge of trench (in which space shoring equipment must fit) and applies to the pipeline, while manhole excavation is assumed to be 10'x'10'. The estimated quantities for asphalt removal and replacement are based on the noted trench width (6' or 4') plus the additional width as indicated in Detail 1 Sheet C-506. For example, the estimated asphalt quantities around manholes in paved areas are based on a 12'x12' full depth removal and a 14'x14' T-Top. Please note, the estimated trench quantities are conservative, as a 6' trench width was assumed for even the very shallow gravity sewer sections and Imported Trench Backfill is assumed at a conservative 75% along the project.

Question 38.

Q: Contractor is requesting more information regarding the relocation of existing utilities. Is there a map showing the existing utilities to be relocated and their new alignment?

A: The gas main on 34 Road is anticipated to be relocated into the west shoulder of the road.

Question 39.

Q: There are two details for cut off walls. Can owner provide locations of where which cut off wall is required?

A: Flowfill cutoff walls are required where indicated in the profile views ("Flowfill Cutoff Wall") of Sheets C-202, C-203, C-210, C-211, and C-218. Standard cutoff walls (indicated as "Cutoff Wall") shall be used at all other locations.

Question 40.

Q: Is there any requirement for bypass pumping required for the drain crossings on Sheets C-301 and C-302?

A: Bypass pumping requirement will be based on flow within the ditches, which is dependent on location, time of year, and weather.

Question 41.

Q: Is there any warranty required on the private property items that are the removed and replaced?

A: Standard warranty applies.

Question 42.

Q: Contractor is requesting the addition of a bid item addressing the removal and replacement of private property items.

A: Removal and replacement of private property items is addressed under the pay item "Property Removals and Restoration."

Question 43.

Q: Will debris on private property be moved by time of construction?

A: In the C-400 Drawings, rubbish and debris (such as tires, wood piles, old equipment, etc.) are identified as to be "Addressed under relocation." This means that the landowner is responsible for removal/relocation of such items prior to construction.

Question 44.

Q: Contractor is requesting if item will be added to the bid tab for hazardous material removal and disposal regarding the shooting range?

A: The shooting range as indicated on Sheet C-204 is the landowner's small, private facility. The landowner has requested all excess material generated from excavation to be deposited on their property, therefore no removal or disposal is necessary at this location.

Question 45.

Q: Is contractor to include an allowance of fruit bearing vegetation on private property? Has town negotiated the replacement of these items with landowners?

A: No fruit trees are to be replaced by the Contractor. In the C-400 Drawings, fruit trees are identified as "to be removed by project." This means that the Contractor shall remove these items (if necessary), but does not need to replace them as the landowners have already been compensated for replacement.

Question 46.

Q: Contractor is requesting more information regarding the systems integration. Has the owner already contracted out the systems integration? Or are they looking for proposal for system integration to be included within this proposal?

A: SCADA integration will be by Clifton Sanitation District. They have an in-house integrator.

Question 47.

Q: Contractor is requesting information about existing water main to be replaced. Can the existing water main be shut off for duration of removals and replacements?

A: Waterline can be shutdown for the duration of the replacement. Coordinate shutdown with Clifton Water District.

Question 48.

Q: Contractor is requesting the depths of which the Piezometers were installed to. Are we to assume a depth below the measured ground water depths?

A: The piezometers were installed to the following depths: - F Rd & 34 Rd = 20', Lift Station = 28', 35 1/2 Rd = 20', Canal Crossing = 16'.

Question 49.

Q: Contractor is requesting CAD files be shared for earthwork estimating purposes. Can owner provide CADs?

A: CAD files will be provided to the contractor after award of this project, however will not be provided during the bidding process.

Question 50.

Q: Contractor is requesting confirmation on the AIS requirements for the project. Do the AIS requirements fall into the same category as the USDA's BABA requirements? To say contractors should not bid AIS requirements and if desired they will be negotiated into the contract of the awarded contractor?

A: AIS requirements are mandatory to the project.

Question 51.

Q: The roof panels are called out to be 16" MBCI metal panels but does not specify thickness. MBCI comes in 22 or 24 gauge steel. Please confirm thickness for the MBCI panels.

A: Details on 2 & 3 Sheet S-510 call out 26 gage, however 24 gage is acceptable.

Question 52.

Q: Gutters and downspouts are called out as pre-finished aluminum. Please confirm gutters and downspouts do not need to match the metal panel material and should be priced as aluminum.

A: Intent is to match metal panel color, however the colors can be coordinated with the Owner's approval.

Question 53.

Q: Can specifications be included in a forthcoming addendum for the Refrigerated Composite Sampler? I understand that needs to be an Emerald Coast or equal, but it would provide a benefit to have more detail specifications and requirements on that."

A: Yes, see specification Section 11 53 23 Refrigerated Composite Sampler.

Question 54.

Q: Due to the Odor Control System manufacturer switch, would it be possible to provide updated Odor Control Specifications? That way we can double check the package the manufacturers or reps send us to the specification.

A: The Vapex and Heartland manufacturers have coordinated their system design and proposals with the Owner and Engineer. Please contact the manufacturer representatives for specifics on their proposals.

Heartland Oxygen Generator System:

- *HOX-060-3 oxygen generation system (indoor unit - no built in AC)*
- *Control Box*
- *120 Gallon O2 Tank*
- *Contact Heartland Oxygen Systems, LLC for proposal:*

Derek Eltiste, President & Owner

derek@heartlandoxygen.com

Phone: 913-522-2500

Vapex Ozone System:

- *Nano ozone generation system (indoor unit – no built in AC)*
- *Qty. 2 drop-down nozzles to be installed in wet well*
- *¾" potable water supply to unit – will require PRV on the water service line to keep pressure between 25-75psi.*
- *Contact Coombs Hopkins for proposal:*

Jason Morgan, Sales Engineer

jmorgan@chcwater.com

Office: 303-477-1970

Cell: 801-691-4000

Question 55.

Q: Please confirm per D-101 thru D-303, applicable KN #20, #25 and #39 SS pipe is to be 316SS.

A: 304SS is acceptable.

Question 56.

Q: Per D-301/KN #37 and Detail D-05100/D-501, please confirm if the vent piping should be a 4" minimum as called out in note #3 of the detail, or if a larger size is required.

A: Please provide 6" diameter ventilation pipe.

Question 57.

Q: Per D-301/KN#5, please specify what type of flex tubing is to be ran from the Air Release Assy to the sump.

A: PTFE tubing. However, Sch 80 PVC is also acceptable.

Question 58.

Q: Please confirm local Utility is providing the Utility Transformer and Utility Meter. If possible, please confirm anticipated timeframe when these items will be ready and set by Utility.

A: Xcel will be providing the transformer and meter. Anticipated timeframe is a couple months from the time the service application is submitted to Xcel (this will not be done until after Award and coordination with Contractor on desired timing).

Question 59.

Q: Please confirm if Flygt is to supply the pump VFD along with the VFD Control Panel.

A: Yes, Flygt will be providing the pump VFD and VFD Control Panels. Please contact Bret Bernarding, the Flygt pump representative, for details on the pump control panels. Bret Bernarding can be reached at bbernarding@cogentcompanies.com, 303-524-6930 (Direct), or 816-221-0650 (Main).

Question 60.

Q: Section 40 95 00 (Programmable Logic Controllers) references related section such as 26 29 23 - Variable Frequency Drives. There is not 26 29 23 Variable Frequency Drive specification, please provide.

A: Please contact Bret Bernarding, the Flygt pump representative, for details on the pump control panels. Bret Bernarding can be reached at bbernarding@cogentcompanies.com, 303-524-6930 (Direct), or 816-221-0650 (Main).

Question 61.

Q: It is unclear what type of underground or duct bank is necessary for the Lift Station site plan. Specifically at the transformer and generator to the Lift Station, please provide clarity or detail.

A: Underground conduit information is listed in the Wire Schedule on Sheet E3-1 below the one-line diagram. Basis of design conduit is Schedule 80 PVC in any area subject to physical damage and Schedule 40 PVC where permitted.

Question 62.

Q: C-212 profile depicts the 18" Sewer Line to connect to the Lift Station Wet Well as SDR-35 PVC with no pipe material type transition. D-101 depicts the Lift Station connection to the Lift Station as 18" D.I. Pipe. Please confirm where the transition is and applicable details, or if the connection is to follow C-212 with SDR-35 pipe material.

A: This pipe is to be DI and the Contractor should reference detail C-02123 on Sheet C-503 for the pipe to structure transition between those structures.

Question 63.

Q: Please confirm that the pipe material type from the Lift Station Dry Well Pump Discharge to the Pigging Station is to be DI Pipe. It appears as such per D-101, but it is not clear from C-212 profile.

A: Yes, this is to be DI pipe.

Question 64.

Q: Do we need to provide a temp docking station as note #6 on plan sheet E3-1 states?

A: Due to the nature of the usage and the function of the generator as Emergency (NEC 700), yes a docking station for a temporary generator is required. It would be basically a manual transfer switch to "disconnect" the permanent generator and "connect" the temporary generator so that the Emergency backup is always available.

Question 65.

Q: Who is responsible for the CCTV inspection of the new sewer line?

A: The contractor shall be responsible for performing final CCTV inspection of sanitary sewer line. The owner/engineer will oversee inspection/review.

Question 66.

Q: Who is responsible for the deflection testing of the new line?

A: The contractor shall be responsible for performing deflection testing of sanitary sewer line. The owner/engineer will oversee inspection/review.

Question 67.

Q: I see the plan sheets and specs talk about flushing the new line. It doesn't mention jet cleaning if the new line. Is jet cleaning required and if so, is it the responsibility of the GC?

A: Jet cleaning won't be required as part of the standard testing/cleaning requirement.

Question 68.

Q: In section 7.19 'Delegation of Professional Design Services', does this section refer to submittals and shop drawings or something more? Please clarify the intent of this section.

A: This section is used when a construction contract expressly assigns to the contractor responsibility for the final design (and construction) of a specific element of the completed, functioning project. This will apply to submittals that require a licensed design professional.

Question 69.

Q: Plan sheet C218 at approximate Sta. 198+40 it says to 'Remove & Replace Wingwall (in kind)', this matches with Bid Item #7. Is there a detail of how the Wingwall should be constructed?

A: Contractor shall match existing wingwall design and materials. No design has been provided. Please see photo below of existing structure.



Question 70.

Q: Plan sheet C512, detail 3 shows the Headwall Connection construction requirements. At what station does this Headwall get constructed?

A: Detail 3 Sheet C-512 applies to Detail 2 Sheet C-301, which is at approximate STA 140+25.

Question 71.

Q: Where can I find the specifications to the requirements of the pump control panels that are to be provided by the pump manufacturer?

A: Contact Bret Bernarding, the Flygt pump representative, for details on the pump control panels. Bret Bernarding can be reached at bbernarding@cogentcompanies.com, 303-524-6930 (Direct), or 816-221-0650 (Main).

Question 72.

Q: Is it possible to get a more complete Measurement and Payment section, 01250, of the specs that gives a complete list of all the bid items?

A: Measurement and payment descriptions are only provided for non-standard items. Measurement for these items will be made based on units described in C-410, and installation requirements are provided throughout the project specifications and CDOT Standards.

Question 73.

Q: Does there need to be temporary power at the Lift Station site for construction?

A: No. Since this a new lift station there is nothing that needs to be powered during construction.

Question 74.

Q: Does either CSD or the Town have a place to take the Unclassified Excavation export material? Or, does it become the property of the GC?

A: This material becomes property of the Contractor. Also, per Note #4 of Parcel 294105300124 on Sheet C-402, the Landowner desires excess dirt so Contractor could inquire with Landowner regarding quantity.

Question 75.

Q: Would Contech's A-2000 PVC pipe meeting the ASTM F 949 and F 794 Sewer Pipe specification be considered and acceptable alternative to the SDR35 for the Palisades Sewer Line Transfer Project?

A: Contech's A-2000 Profile Wall pipe appears to meet the requirements provided in Technical Section 2 – 102.7a of the Specifications for sewer lines 15" and larger in diameter, and therefore would be permitted. The minimum utility and casing clearances provided in the drawings must still be maintained, and pipe types must be consistent manhole to manhole.

Question 76.

Q: Bid items #12 & #13- PVC restrained pipe, are you wanting something like C900 DR14 Certalok or Eaglelok? If not please clarify "restrained Joint".

A: Pipe shall be restrained to prevent separation due to internal thrust effects. Pipe restraint method shall be up to contractor's means and methods.

Question 77.

Q: Bid items #14-#17- Restrained bends, are you wanting MJ DI fittings (epoxy coated per spec UU-4 of 26) with lug restraint like EBAA Megalug or Star Grip? If not please clarify "restrained bend". -Epoxy coating…verify epoxy coating is wanted and not a sewer coating like P401?

A: Pipe shall be restrained to prevent separation due to internal thrust effects. Pipe restraint method shall be up to contractor's means and methods. Epoxy coating shall be used per project specifications.

Question 78.

Q: Bid item #20- Bid schedule shows qty 28, I only find 25? Is there any fitting connections to existing service pipe needed? Or just cap and marker per detail, meaning connect to existing pipe is by others?

A: There are 28 Sewer Service Stub-Outs. Stub-outs will not be connected to any existing pipe as there are no existing sewer services (stub-outs are intended for future use). Stub-outs shall be capped and marked for future connection by others.

Question 79.

Q: Are you paying for stored materials? Are you expecting to purchase the full qty of PVC pipe at the beginning of the project?

A: 01200 Price and Payment Procedures has been modified to allow for the partial payment of stored materials.

Question 80.

Q: Also, as noted in the specs IPS PVC pressure pipe will be accepted, what pressure rating?

A: Pipe class requirements can be found in plan and profile sheets of plans.

Question 81.

Q: Bid #4, 16” A/C replacement- Will Hymax or an equal restrained coupling be accepted in place of the solid sleeves?

A: Yes.

Question 82.

Q: What gauge wire for tracer wire? Also the main shows grounding rod but the force main shows actual test stations?

A: 12ga is acceptable for all tracer wire. Tracer wire will be required for installation on all sewer mains and is incidental to the cost of the sewer pipe. The force main shall have test stations and gravity sewer shall have ground rods at the manholes.

Question 83.

Q: Per the details on sheet C-301, are we to include new 12" SDR drain line with drain Crossing and the removal of the existing lines?

A: Yes, removal of existing pipes and installation of new pipes shall be included in the Drain Crossings pay item.

Question 84.

Q: Also, on sheet C-301: the supply and installation of the pit run materials- Are these aggregates included in the drain crossing or are the materials included in the bid item #40 Pit Run Fill?

A: The pit run backfill shown on Sheet C-301 shall be paid for with the Pit Run Fill pay item and these quantities are included in the estimated quantity. The Drain Crossings pay item states that it does not include pit run fill material.

Question 85.

Q: Can you provide a typical year dates ie: 10/31-4/01? When canal is fully drained?

A: Please see below table showing approximate canal opening/closing dates based on flow measurement data at the Grand Valley Canal diversion (from https://dwr.state.co.us/Tools/Stations).

YEAR	*Last Day Zero Flowrate*	*First Day Zero Flowrate*
2024	*April 2nd*	*November 1st*
2023	*April 8th*	*October 31st*
2022	*March 23rd*	*November 3rd*
2021	*April 3rd*	*November 5th*
2020	*April 5th*	*November 5th*
2019	*March 31st*	*November 5th*
2018	*April 1st*	*November 8th*
2017	*April 3rd*	*November 1st*
2016	*April 4th*	*November 1st*
2015	*March 31st*	*November 2nd*
2014	*April 1st*	*November 1st*

Question 86.

Q: Can you provide us a manufacturer name of the polymer manholes?

A: Armorock is an example of a polymer concrete manhole manufacturer and they were also in attendance at the pre-bid meeting.

Question 87.

Q: Under which bid item should the cutoff and Flow-Fill Cutoff Walls be included?

A: These cutoff walls shall be incidental to gravity sewer installation and force main installation.

Question 88.

Q: Can you recheck quantity of 5’ Dia polymer Manholes? #9, #23, #25, & #65= 4 each

A: Three is correct. MH-23 is the Force Main Discharge Manhole which will be paid for separately.

Question 89.

Q: What is expected for the Bid Item “Erosion Control (CIP)? Silt fence or straw wattles for both sides of temporary ROW-whole project length?

A: Per General Note #14 on Sheet G-003, the Contractor shall be responsible for preparation of stormwater pollution prevention plan and obtaining all necessary stormwater permits.

Question 90.

Q: Will erosion control measures such as silt fence be necessary for work on 35 Road, F road and Canal access road?

A: Per General Note #14 on Sheet G-003, the Contractor shall be responsible for preparation of stormwater pollution prevention plan and obtaining all necessary stormwater permits.

Question 91.

Q: Can 34 Road & F Road be closed for construction of pipeline and reconstruction of road?

A: Mesa County Road and Bridge Department has stated the following: "We are comfortable letting a contractor close F Road for the construction and just keeping it open to local traffic. With the correct plan it is definitely something we would consider and allow."

Question 92.

Q: What is the required final width of canal road which receives Class 6 Roadbase?

A: The canal road shall be 10' wide according to Detail 2 Sheet C-509. The one exception is from STA 171+25 to 172+50, where the road will be 8' wide.

Question 93.

Q: What is the current flow rate for the existing sewer line that needs to be by-pass?

A: Flows at MH-66 can vary between a daily average of 100-200 GPM. Flows at MH-1 are unknown, but that manhole receives flow from 40 houses and Mt. Garfield Middle School.

Question 94.

Q: Under which pay item should de-watering be included?

A: Dewatering shall be incidental to gravity sewer installation, force main installation, and construction of the lift station.

Question 95.

Q: On sheet C-506 of the plans, detail 1, it shows a maximum width of 3 feet for an 18" pipe. This width will also be the width of the stabilization material, if needed. Section 13.03 of the Standard General Conditions state that actual quantities will be paid. Will stabilization material payment be limited to the maximum trench width as shown in the detail? Also, the same detail shows fabric, if needed and directed by the engineer. There is no bid item for the fabric. How will this be paid, if needed?

A: Stabilization material will be paid according to the actual quantity used, per weight tickets. The estimated quantity of 21,435 tons is based on a conservative assumption of 6' width for gravity sewer sections and 4' width for force main sections, at a thickness of 2' and 100% use throughout the project. Fabric is not

anticipated to be used. If fabric is used, a unit price will be negotiated at that time.

Question 96.

Q: Plan notes show trench width of 6’ for gravity sewer and 4’ for force main. Assuming this is the anticipated asphalt removal width, if additional asphalt is removed beyond these limits, will the additional cost of removal and replacement be the responsibility of the contractor?

A: The estimated quantities for asphalt removal and replacement are based on the noted trench width (6' or 4') plus the additional width as indicated in Detail 1 Sheet C-506. For example, Removal of Asphalt Mat (Full Depth) quantity is based on trench width plus 1' on each side. As another example, T-Top Mat pavement is based on trench width plus 2' on each side. Additionally, along 34 Road where trench is near west edge of road, our estimated quantities assume removal of the small extra distance to existing edge of asphalt. Also, please note that manhole excavation has been estimated at 10'x10', with 12'x12' full depth asphalt removal and 14'x14' T-Top area factored into the estimated quantities.

Question 97.

Q: How will lump sum bid items be paid for during construction of the project? Will they be prorated and a portion paid based on percent complete of the item or percent complete of the project on the monthly pay estimates?

A: Lump Sum pay items without an agreed upon Schedule of Values may be paid upon a Percent Complete amount where reasonable and appropriate.

Question 98.

Q: Will materials on hand be paid for? Pipe and equipment suppliers will want paid for materials once delivered. Due to the size of the project, they will want to drop ship entire order and not break up into smaller shipments over a 2 year period.

A: 01200 Price and Payment Procedures has been modified to allow for the partial payment of stored materials.

Question 99.

Q: Would the Cretex Pro Ring be approved as an equal to the concrete grade rings for this project? The City of Grand Junction has approved of this item being used in previous projects. I have attached information about the ring below. We are CDOT approved as well and have even done a demo about a year and a half ago. I also have attached information on the epoxy coating that is called out in the specs for the manholes as well. I included the mortar that would be used for manhole rehab before placing the epoxy coating on if needed. Will these be viewed for possible approval on this project?

A: Yes, Cretex Pro Rings would be accepted for this project.

Question 100.

Q: Please confirm the flow in gallons per minute each of the two Flygt 45 HP lift station pumps for this project.

A: The pumps should be designed for 782 gpm at 120 ft TDH and the pump control panels shall be provided by the manufacturer (Flygt).

Question 101.

Q: Would C900 Fusible PVC be an acceptable material for the forcemain?.

A: Fusible PVC may be considered as an appropriate pipe material alternative for the forcemain section only. For the use of this material to be considered, a design sealed by a professional engineer licensed in the state of Colorado must be provided which demonstrates the design complies with AWWA standards and restraint requirements. Additionally, pipe must be installed so as to prevent high points in the alignment which may entrap air in the system.

END OF SECTION

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SECTION 01200

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Unit prices.

B. Applications for payment.

C. Change procedures.

D. Defect assessment.

E. Alternates.

1.2 UNIT PRICES

A. Authority: Measurement methods are delineated in section 01250 Measurement and Payment.

B. Measurement methods delineated in individual specification sections complement criteria of this section. In event of conflict, requirements of individual specification section govern.

C. Take measurements and compute quantities. Engineer will verify measurements and quantities.

D. Unit Quantities: Quantities and measurements indicated in Bid Form are for contract purposes only. Quantities and measurements supplied or placed in the Work shall determine payment.

1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit sum/prices contracted.
2. When actual Work requires 25 percent or greater change in quantity than those quantities indicated, Owner or Contractor may claim for Contract Price adjustment.

E. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit.

F. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.

G. Measurement of Quantities:

1. Weigh Scales: Inspected, tested and certified by applicable state Weights and Measures department within past year.

2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
3. Metering Devices: Inspected, tested and certified by applicable State department within past year.
4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
5. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
6. Measurement by Area: Measured by square dimension using mean length and width or radius.
7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as completed item or unit of the Work.

1.3 APPLICATIONS FOR PAYMENT

A. Applications for payments shall be submitted according to Town of Palisade standard procurement procedures and submitted on forms designated in those standards.

B. Substantiating Data: When Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with application:

1. Revised and current construction progress schedule

C. Partial payment for unit price bid items and lump sum bid items only partially completed at the end of monthly pay periods will not be made. Partial payment for materials delivered and stored may be made.

1.4 CHANGE PROCEDURES

A. Submittals: Submit name of individual authorized to receive change documents and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. The Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions using a Work Directive Change.

C. The Engineer may issue a Notice of Change including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with stipulation of overtime work required and the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within 7 days.

D. Contractor may propose changes by submitting a request for change to Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01330.

E. Unit Price Change Order: For contract unit prices and quantities, the Change Order will be executed on fixed unit price basis. For unit costs or quantities of units of work which are not pre-determined, execute Work under Work Directive Change. Changes in Contract Sum/Price or Contract Time will be computed as specified for Time and Material Change Order.

F. Work Directive Change: Engineer may issue Work Directive Change, signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.

G. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.

H. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

I. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.

J. Change Order Form provided in these specifications.

K. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.

L. Correlation of Contractor Submittals:

1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Engineer, it is not practical to remove and replace the Work, the Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Engineer.

D. Defective Work will be partially repaired to instructions of Engineer, and unit sum/price will be adjusted to new sum/price at discretion of Engineer.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Engineer to assess defects and identify payment adjustments is final.

G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from transporting vehicle.
4. Products placed beyond lines and levels of required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected products.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01250

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stipulations

B. Schedule of Bid Items

1.2 STIPULATIONS

A. Measurement and payment to furnish and install or construct a particular Bid Item will be considered as payment in full for furnishing all labor, equipment, materials, supplies, tools and miscellaneous apparatus necessary for a complete item, and the aggregate payment of all Bid Items will constitute full compensation to construct a complete and workable Project as specified.

B. Payment for all items shall be at the unit price listed in the bid schedule. Payment will be withheld for any material or work not completed in accordance with these specifications and/or not passing required tests.

C. No measurement and payment will be made for any incidental work that is not specifically identified in this Division but is necessary for a complete and workable Project as specified. This includes, but is not limited to, dewatering, submittals, certifications, and materials testing.

D. Unit quantities listed under the Base Bid reflect the anticipated quantities for the Base Bid only. Additional quantity of an item due to the selection of one of the Options will be paid for under the Base Bid unit price unless specifically noted otherwise.

1.3 NOT USED

1.4 SCHEDULE OF BID ITEMS

A. Remove Existing Pipe (BID ITEM 2)

1. Measurement: Linear Foot.

2. Payment: Includes providing all Labor, Materials and Equipment to remove and dispose of existing sewer pipes and water pipes per the Drawings and Specifications.

B. Removal of Manhole (BID ITEM 3)

1. Measurement: Each.

2. Payment: Includes providing all Labor, Materials and Equipment to remove and dispose of existing sewer manhole at STA 10+00.

C. 16” A.C. Pipeline Replacement (BID ITEM 4)

1. Measurement: Lump Sum.

2. Payment: Includes providing all Labor, Materials and Equipment to remove and dispose of existing A.C. material, and furnishing and installing all water lines and fittings per the Drawings and Specifications.

   Contractor to coordinate with Clifton Water District for waterline shutdown.

D. Wetland Protection and Restoration (BID ITEM 5)

1. Measurement: Square Yard.

2. Payment: Includes providing all Labor, Materials and Equipment to protect and restore wetlands per the Drawings and Specifications (20’ corridor where project alignment crosses wetland areas). This includes any wetlands within the 20’ corridor that are not disturbed and are effectively protected in place. Also includes any necessary protective measures.

E. Remove and Replace Wingwall (BID ITEM 7)

1. Measurement: Lump Sum.

2. Payment: Includes providing all Labor, Materials and Equipment to remove and dispose of existing bridge wingwall and to furnish and install replacement wingwall in-kind.

F. Pipeline Plugging (BID ITEM 8)

1. Measurement: Each.

2. Payment: Includes providing all Labor, Materials and Equipment to plug pipe ends per the Drawings and Specifications, including Detail 2 Sheet C-508. Plugging of each pipe end will be paid separately. This item does not include payment for removed pipe sections, which shall be paid for under Remove Existing Pipe (Bid Item 3).

G. Sewer Service Stub-Out (BID ITEM 20)

1. Measurement: Each.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install sewer service stub-outs per the Drawings and Specifications, including Detail 3 Sheet C-511.

H. Sanitary Sewer Basic MH 60” Dia (BID ITEM 21)

1. Measurement: Each.

2. Payment: Payment: Includes providing all Labor, Materials and Equipment to furnish and install basic sanitary sewer manholes per the Drawings and Specifications. The basic manhole components include the base, eccentric cone, grade rings, ring and cover (including bolted watertight covers, if applicable) and adjustment to final grade. Does not include polymer concrete manholes or Manhole 24, which are paid for separately.

I. MH Barrel Section D>5’ 60” (BID ITEM 22)

1. Measurement: Vertical Linear Foot.

2. Payment: Payment: Includes providing all Labor, Materials and Equipment to furnish and install manhole barrel sections per the Drawings and Specifications. The pay length for the manhole barrel will be the height from the lowest invert to the top of the ring minus five (5) feet. Manholes less than five (5) feet deep will be paid for under the basic manhole components only. This item does not apply to polymer concrete manholes.

J. Force Main Discharge Manhole (MH-23) (Polymer Concrete) (BID ITEM 23)

1. Measurement: Lump Sum.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install the polymer concrete MH-23 (Force Main Discharge Manhole) per the Drawings and Specifications.

K. MH Coating (BID ITEM 24)

1. Measurement: Vertical Linear Foot.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install manhole invert coatings and manhole corrosion protection coatings per the Drawings and Specifications. Also includes surface preparation, application, and testing of coatings. No differentiation in payment shall be made between coatings applied off-site or on-site.

L. Polymer Concrete MH 60” Dia (BID ITEM 25)

1. Measurement: Each.

2. Payment: Payment: Includes providing all Labor, Materials and Equipment to furnish and install polymer concrete sanitary sewer manholes per the Drawings and Specifications. The basic polymer concrete manhole components include the base, eccentric cone, grade rings, ring and cover (including bolted watertight covers, if applicable) and adjustment to final grade.

M. Polymer Concrete MH Barrel Section D>5’ 60” (BID ITEM 26)

1. Measurement: Vertical Linear Foot.

2. Payment: Payment: Includes providing all Labor, Materials and Equipment to furnish and install polymer concrete manhole barrel sections per the Drawings and Specifications. The pay length for the polymer concrete manhole barrel will be the height from the lowest invert to the top of the ring minus five (5) feet. Polymer concrete manholes less than five (5) feet deep will be paid for under the basic manhole components only

N. Polymer Concrete MH 72” Dia (BID ITEM 27)

1. Measurement: Each.

2. Payment: Payment: Includes providing all Labor, Materials and Equipment to furnish and install polymer concrete sanitary sewer manholes per the Drawings and Specifications. The basic polymer concrete manhole components include the base, eccentric cone, grade rings,

ring and cover (including bolted watertight covers, if applicable) and adjustment to final grade.

O. Polymer Concrete MH Barrel Section D>5’ 72” (BID ITEM 28)

1. Measurement: Vertical Linear Foot.

2. Payment: Payment: Includes providing all Labor, Materials and Equipment to furnish and install polymer concrete manhole barrel sections per the Drawings and Specifications. The pay length for the polymer concrete manhole barrel will be the height from the lowest invert to the top of the ring minus five (5) feet. Polymer concrete manholes less than five (5) feet deep will be paid for under the basic manhole components only

P. Riverbend Irrigation Structure (BID ITEM 29)

1. Measurement: Lump Sum.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install the improvements to the existing Riverbend irrigation structure per the Drawings and Specifications, including Detail 2 Sheet C-511. Includes removal of existing headgate structure. Does not include furnishing and installing new headgate structure, which will be performed by GVIC. Includes installing new pipe and connecting to headgate.

Q. Drain Crossings (BID ITEM 30)

1. Measurement: Each.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install the drain crossings per the Drawings and Specifications, including Sheets C-301 and C-302. Includes removal and replacement of existing pipes and connection to RCP pipe. Does not include pit run fill material, which will be paid separately.

R. Gates (BID ITEMS 31 & 32)

1. Measurement: Each.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install new Driveway Gates and Fence Gates per the Drawings and Specifications, including Details 1 and 2 on Sheet C-512. This item does not include work relating to existing gates that may be removed and replaced as part of the Project.

S. Granular Stabilization Material (Type B) (BID ITEM 37)

1. Measurement: Ton

2. Payment: Granular Stabilization Material will only be approved for payment where required due to unstable trench bottom and where permitted by the Engineer. Where approved for use, payment will include all Labor, Materials and Equipment to install material per the Specifications.

T. Imported Trench Backfill (Class 3) (BID ITEM 38)

1. Measurement: Ton

2. Payment: Imported Trench Backfill material will only be approved for payment where required due to poor soil conditions and where permitted by the Engineer, or where specifically called out in the Drawings. Where approved for use, payment will include all Labor, Materials and Equipment to install material per the Specifications.

U. Canal Crossing (BID ITEM 39)

1. Measurement: Lump Sum.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install the steel sleeve and concrete encasement for the canal crossing at STA 198+50 to STA 199+75 per the Drawings and Specifications.

V. Pit Run Fill (BID ITEM 40)

1. Measurement: Ton.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install the pit run fill material per the Drawings and Specifications. Includes filling of the canal belly and backfill of drain crossings.

W. Canal Wall Soil Replacement (BID ITEM 41)

1. Measurement: Cubic Yard.

2. Payment: Includes providing all Labor, Materials and Equipment to furnish and install canal wall soil replacement per the Drawings and Specifications, including Detail 3 Sheet C-513. Includes removal and replacement of native material, disposal of excess native material, and placement of pitrun on canal bank.

X. Property Removals and Restoration (BID ITEM 42)

1. Measurement: Lump Sum.

2. Payment: Unless otherwise itemized separately in the Unit Price Schedule, Payment will be made at the contract lump sum price based on agreed upon Schedule of Values submitted by the Contractor. This includes providing all Labor, Materials and Equipment to protect, remove, perform tree removal, salvage and stockpile existing features, and to furnish and install improvements to Private Properties per the Drawings and Specifications, including Sheet C-401 through Sheet C-404. Does not include any items designated as to be addressed under relocation, as such items are not part of the Project and are for Contractor's information only. Contractor's means and methods will dictate extent necessary for removal, salvage, replacement, and restoration of items within the limits of the Permanent and Temporary Easements. Includes Contractor coordination with Landowners as required by the Drawings and Specifications. This item is all encompassing for complete-in-place restoration of properties provided in C-400 sheets. The quantities and items provided in C-400 sheets have been agreed upon with the relevant property owners, and for the purpose of this pay item are not quantifiable.

Y. Riverbend Park Removals and Restoration (BID ITEM 43)

1. Measurement: Lump Sum.

2. Payment: Unless otherwise itemized separately in the Unit Price Schedule, Payment will be made at the contract lump sum price. This includes providing all Labor, Materials and Equipment to protect, remove, salvage and stockpile existing features, and to furnish and install improvements to as necessary to complete the work between STA 200+00 to STA 283+00 that is not specifically listed and paid for elsewhere. Includes restoration of surfaces to match existing, including replacement of gravel surfaces and reseeding of grass areas. Contractor's means and methods will dictate extent necessary for removal, salvage, replacement, and restoration of items.

Z. Bypass Pumping (BID ITEM 49)

1. Measurement: Lump Sum.

2. Payment: The design and construction of all necessary temporary bypass pumping will be the contractor's responsibility. Contractor shall provide a bypass pumping plan for each set up and is responsible for establishing the pump capacity necessary for the bypass system. Redundancy of pumping capacity to safely bypass flow in the existing lines associated with this project and ensuring lines above the work zone are not surcharged will be the Contractor's responsibility. Damages caused by failure of bypassing will be Contractors responsibility.

AA. Traffic Control Plan (BID ITEM 52)

1. Measurement: Lump Sum.

2. Payment: A Traffic Control Plan shall be prepared by the Contractor and reviewed by the District two days prior to the pre-construction meeting. The Contractor shall provide and maintain all traffic control in accordance with this Traffic Control Plan and the Manual on Uniform Traffic Control Devices. The Contractor shall provide all traffic control measures and responsible oversight in accordance with Mesa County and CDOT permits.

BB. Preparation and Distribution of Newsletters (BID ITEM 54)

1. Measurement: Lump Sum.

2. Payment: Includes providing all Labor, Materials and Equipment to prepare and distribute newsletters every two weeks to those properties along the Project alignment that will be impacted by construction within the upcoming month. This shall include general information about the Project including interruptions in utility services, street closures, parking restrictions, project schedule, and the names and numbers of the contacts for the Town of Palisade and Contractor. Contractor shall coordinate with the Town at least 72 hours prior to road closures and utility interruptions. Contractor shall be responsible for notifying all businesses and/or residents located adjacent to the work. Door hanger notifications shall be distributed at least two (2) working days prior to the day the work is scheduled to occur, unless indicated otherwise in the Project Documents.

CC. Quality Control Testing (BID ITEM 56)

1. Measurement: Lump Sum.

2. Payment: Includes all Labor, Materials and Equipment required by the Contractor to perform quality control testing per the Drawings and Specifications. Includes Contractor's coordination and scheduling of testing.

DD. Minor Contract Revisions (BID ITEM 57)

1. Measurement: Force Account.

2. Payment: Includes all Labor, Materials and Equipment required by the Contractor to perform unforeseen work that is determined to be necessary for completion of the Project.

EE. Lift Station (BID ITEM 60)

1. Measurement: Lump Sum.

2. Payment: Unless otherwise itemized separately in the Unit Price Schedule, Payment will be made at the contract lump sum price based on agreed upon Schedule of Values submitted by the Contractor. Included in this item are all costs relating to equipment, materials, and labor for site preparation, excavation, disposal of excess excavated material, backfill, compaction, watering/dewatering, erosion control, SWPPP compliance, pig launching vault and pipe-to-structure transition, wet well, dry-pit, installation of pumps and ancillary mechanical equipment, odor control system, finished grading, finished site surfaces, concrete approaches/aprons, asphalt, landscaping, fencing, and site restoration. Regarding gravity and force main piping, the Lift Station pay item includes everything between the 8" DI/PVC Joint Restraint Coupling downstream of the pigging station (Detail A Sheet C-501) and Manhole 24 (including piping from lift station to MH-24 and MH-24 appurtenances including plug valve per Detail 1 Sheet C-502) (Detail 1 Sheet C-502). The Lift Station pay item also includes a new CMU building and components including; building foundation, floors, walls, roof systems, overhead crane, metals, finishes, coatings, thermal and moisture protections, mechanical HVAC/plumbing, and all building related architectural and structural components. All electrical work, controls, and instrumentation are also included, with the exception of the transformer which will be installed by Xcel. Installation of 1-1/2" water service line between water meter and lift station is also included. Ute Water will complete all water service work between the water main and meter (including tap, water service line within ROW, meter pit, and meter assembly), and requires 60 days notice from the Contractor prior to this work. All other items not specifically mentioned within previous categories but required for a complete and fully functional lift station to be included in this item, including project startup, commissioning, compliance, training, and testing.

FF. Headworks Demolition (BID ITEM 62)

1. Measurement: Lump Sum.

2. Payment: Includes all Labor, Materials and Equipment required to demolish, haul, and properly dispose of the lagoon headworks building and appurtenances as indicated on Sheet C-702. Also includes backfill and site restoration as indicated on the Plans. Also includes abandonment of lagoon discharge pipe by concrete plugging as indicated on C-701.

GG. Sludge/Liner Disposal (BID ITEM 63)

1. Measurement: Ton.

2. Payment: Includes all Labor, Materials and Equipment required to test, remove, haul, and properly dispose of the sludge, liners, geotextiles, floating baffles, and other appurtenances as indicated on Sheet C-701. This pay item assumes sludge will meet the testing requirements to be considered non-hazardous waste for disposal. If testing requirements are not met, alternative disposal methods will be required and price will be negotiated at that time.

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Field engineering.

B. Preconstruction meeting.

1.2 FIELD ENGINEERING

A. Verify drawing dimensions and elevations.

1.3 PRECONSTRUCTION MEETING

A. Engineer will schedule meeting after Notice of Award.

B. Attendance Required: Owner, Engineer, Utility Companies and Contractor.

C. Agenda:

1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of products.
5. Designation of personnel representing parties in Contract, and Engineer.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Submission of Work sequence plan, Schedule

D. Engineer will record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, and those affected by decisions made.

1.4 PROGRESS MEETINGS

A. The Engineer will schedule and administer progress meetings. Additional meetings as needed by Owner, Contractor, vendor(s), and/or agencies throughout progress of the Work shall also be scheduled and administered by the Engineer.

B. Attendance Required: Contractors project manager, Contractors site superintendent, Contractors major subcontractors and suppliers, Owner, Engineer, funding agencies (as applicable), and others as considered necessary by Owner or Engineer during the work and as appropriate to agenda topics for each meeting.

C. Agenda:

1. Review minutes of previous meetings.

2. Review of Work progress and changes made or proposed to the Contract Documents.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Contractors maintenance of progress schedule.
8. Contractors proposed corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress, including scheduling of special inspections, planned shutdowns/outages, and major work items.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Funding agency, local, state, and federal requirements affecting the Work.
14. Applications for payment.
15. Other business relating to the Work.

D. Meetings are anticipated to occur every other week, but may be delayed depending on progress of the Work

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Construction progress schedules.

C. Proposed products list.

D. Product data.

E. Certificates.

F. Manufacturer's instructions.

G. Pre-Construction photographs.

1.2 SUBMITTAL PROCEDURES

A. Transmit each submittal with Engineer accepted form.

B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

C. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

D. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

E. Schedule submittals to expedite Project, and deliver to Engineer at **305 Main Street, Suite 6, Palisade, CO 81526**. Coordinate submission of related items.

F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.

G. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.

H. Allow space on submittals for Contractor and Engineer review stamps.

I. When revised for resubmission, identify changes made since previous submission.

J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

K. Contractor shall provide OSHA information and material safety data sheets (SDS) as applicable for all chemicals, as requested by the Engineer or noted in the Contract Documents.

L. Where indicated in the Contract Documents, Contractor shall provide calculations and drawings signed and sealed by a Registered Professional Engineer licensed in the State where the project is to be constructed. Professional Engineer shall be responsible for designing the components as shown on the Shop Drawings.

M. Submittals not requested will not be recognized or processed.

N. The Engineers review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with the requirements of the Contract Documents.

1.3 SAMPLES

A. Contractor shall submit samples when requested in individual sections or as requested by the Engineer.

B. Contractor shall submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

C. Contractor shall submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Owner's selection. Provide custom color samples where custom colors are required by the Contract Documents.

D. Contractor shall include identification on each sample, with full Project information.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within ten days.

B. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

C. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

D. Submit computer generated horizontal bar chart with separate line for each section of Work, identifying first workday of each week.

E. Indicate estimated percentage of completion for each item of Work at each submission.

F. Revisions to Schedules:

1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect.

1.5 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

C. Contractor shall develop submittals as necessary to document proposed goods, materials, systems, plans, etc. for completion of the Work.

D. Shop drawings are required for all process mechanical installations, piping connections to existing piping, fabrications, etc.

E. Fabrication drawings are required for all metal fabrications.

F. Drawings shall include dimensions, fit, and installation, and shall be coordinated with all adjacent Work elements.

G. Shop drawings are not required for yard piping beyond 20 feet from any structure, unless specifically requested by Engineer.

H. Owner and Engineer reserve the right to request such additional submittal items as deemed necessary throughout the course of the Work, at no additional cost to the Owner.

1.6 PRODUCT DATA

A. Product Data: Submit to Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review, produce copies and distribute in accordance with this specification.

1.7 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product but must be acceptable to Engineer.

1.8 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Installation, operation, and maintenance information included with product submittals shall be considered information only. Draft and Final Installation, Operation, and Maintenance information shall be submitted separately from the product data.

D. Contractor shall submit manufacturers printed instructions for delivery, storage, assembly, and installation for all products, except equipment, to be provided as part of the Work. This includes, but is not limited to, coatings, concrete repair products, etc.

E. Contractor shall identify conflicts between manufacturers instructions and Contract Documents as part of the submittal.

1.9 PRE-CONSTRUCTION PHOTOGRAPHS

A. Prior to the commencement of any construction activities, the Contractor shall provide comprehensive photographic documentation of the existing site conditions. This documentation shall serve as a record of pre-construction conditions and shall be used for reference in the event of disputes regarding damage or restoration.

B. The photographs shall include, but not be limited to:

1. All areas within and adjacent to the project limits that may be affected by construction activities.
2. Existing structures, pavements, landscaping, utilities, signage, and any other notable features.
3. Access routes, staging areas, and any off-site areas designated for construction use.
4. All items listed in MOA for restoration.

C. Photographic Standards

1. Photographs shall be high-resolution, color images.
2. Each image shall be time- and date-stamped.
3. Photographs shall be taken from multiple angles to ensure comprehensive coverage.

D. Submission Requirements

1. Photographs shall be submitted in digital format (JPEG or PNG) on a USB drive or via a secure cloud-based platform.
2. Documentation shall be submitted to the Owner and Engineer for review and approval no less than five (5) business days prior to the start of construction.

E. The Owner reserves the right to use the photographic documentation for any purpose related to the project, including dispute resolution and quality assurance.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

Submittal Control Log (Not Exclusive)					
#	**Reference**		**Date Submitted**	**Date Returned**	**Comments**
General Submittals					
1	C700				
2	C800				
3	01330	Pre-Construction Photographs			
Roadway Construction Submittals					
4	CDOT 208	Erosion Control Measures			
5	CDOT 208	Concrete Washout Structure			
6	CDOT 403	Asphalt Mix Design			
7	CDOT 304	Aggregate Base Course			
8	CDOT 630	Traffic Control			
Sanitary Sewer Construction Submittals					
9	Technical Section 2 – 102.7a	Pipe – 18” SDR 35 PVC Sewer Pipe			
10	Technical Section 2 – 102.7b	Pipe – 8” DR-14 PVC Force Main			
11	Technical Section 2 – 102.7	PVC Gravity Sewer Fittings			
12	Technical Section 2 – 102.7b	PVC Force Main Sewer Fittings			
13	Technical Section 2 – 102.8	Precast Sanitary Sewer Manhole, Cleanout Ring and Cover			
14	Technical Section 2 – 102.8	Polymer Concrete Sanitary Sewer Manhole, Cleanout Ring and Cover			
15	Technical Section 2 – 102.9	Manhole Mortar			
16	Technical Section 2 – 102.9	Annular Space Grout Mix and Grouting Plan			
17	Technical Section 2 – 102.11	Water Service			
18	Technical Section 2 – 103.15	Pipe Bedding Gradation (Type A)			
19	Technical Section 2 – 103.15	Granular Stabilization Material			
20	Technical Section 2 – 103.16	Pit Run Backfill			
21	Drawings	Tracing Wire & Splices			
Storm Sewer Construction Submittals					
22	Technical Section 2 – 102.8	Storm Drain Conflict Manhole			
23	Technical Section 2 – 102.10	Reinforced Concrete Pipe			

#	Reference	Date Submitted	Date Returned	Comments
Lift Station Construction Submittals				
24	Technical Section 3 – Division 01			
25	Technical Section 3 – Division 03			
26	Technical Section 3 – Division 04			
27	Technical Section 3 – Division 05			
28	Technical Section 3 – Division 06			
29	Technical Section 3 – Division 07			
30	Technical Section 3 – Division 08			
31	Technical Section 3 – Division 09			
32	Technical Section 3 – Division 14			
33	Technical Section 3 – Division 22			
34	Technical Section 3 – Division 23			
35	Technical Section 3 – Division 26			
36	Technical Section 3 – Division 31			
37	Technical Section 3 – Division 33			
38	Technical Section 3 – Division 40			
39	Technical Section 3 – Division 43			

END OF SECTION

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SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance/control of installation.

B. Conflicting Requirements

C. References.

D. Manufacturers' field services and reports.

1.2 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality.

F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

G. Specified tests, inspections, and related actions do not limit Contractor's right or authority to conduct other quality assurance and quality control procedures that Contractor considers necessary.

H. Contractor shall designate the person responsible for Contractor’s quality control while Work is in progress, and shall notify Engineer, in writing, prior to any change in quality control representative assignment.

I. Contractor shall comply fully with manufacturers' instructions, requirements, and recommendations, including each step in each sequence (e.g., installation sequence, etc.). The use or installation of any product in a manner that differs from the manufacturer’s requirements, recommendations, or instructions shall not be acceptable unless prior written approval from the manufacturer has been received and reviewed by the Engineer and noted as no exceptions taken.

J. Owner will support, appoint, employ, and pay for services of an Independent Testing Firm to perform special inspecting and testing as required per International Building Code (IBC) Chapter 17 within the Structural Footprint.

K. Tolerances

1. Contractor shall monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
2. Comply with manufacturers' tolerances. When manufacturers tolerances conflict with Contract Documents, request clarification from the Engineer before proceeding.

L. Field Samples

1. Store field samples at the site for review as required by individual specification sections.

2. Approved samples represent a quality level for the Work.

3. Where field sample(s) are specified in individual Sections to be removed, clear area after field sample has been accepted by the Engineer.

4. For concrete samples, the Contractor shall provide a temperature-controlled space (i.e., cure box or approved equivalent) on-site that allows the testing firm to store up to 12, 6-inch by 12-inch concrete cylinders for the initial 24-hours after casting. The controlled space shall maintain a temperature between 60-and 80-degrees Fahrenheit as required by ACI.

M. Failure of Contractor to provide adequate notice shall not be grounds for claims of delay by the Contractor.

1.3 CONFLICTING REQUIREMENTS

A. Should any requirements within the Contract Documents appear to conflict, the Contractor shall request clarification from the Engineer before proceeding.

B. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for direction before proceeding.

1.4 REFERENCES

A. Conform to reference standard by date of issue current on date of Contract Documents.

B. Should specified reference standards conflict with Contract Documents, request clarification from Engineer.

C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.5 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site

conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to initiate instructions when necessary.

B. Contractor will report to Engineer, observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report in duplicate within 15 days of observation to Engineer for review.

END OF SECTION

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SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction Facilities:

1. Vehicular access.
2. Parking.
3. Progress cleaning and waste removal.
4. Traffic regulation.

B. Temporary Controls:

1. Barriers.
2. Water control.
3. Dust control.
4. Erosion and sediment control.
5. Noise control.

C. Removal of utilities, facilities, and controls.

D. Notification of Residents

1.2 VEHICULAR ACCESS

A. Minimize disturbance to vehicular access on adjacent streets. Provide traffic control as necessary

B. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.

C. Provide and maintain access to dispensary, distillery, and homes. This includes access to rear delivery doors.

1.3 PARKING

A. Use of designated areas of existing parking facilities by construction personnel is permitted. Do not park vehicles within local business parking lots or residential driveways, or otherwise block residences.

B. Minimize heavy vehicles or construction equipment in parking areas.

1.4 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.5 TRAFFIC REGULATION

A. Coordination:

1. All Traffic control measures shall be coordinated by the contractor with the Town of Palisade Police Department and emergency services prior to modifying both vehicle and pedestrian traffic flow. Any requirements dictated by the above parties beyond those listed below are the responsibility of the contractor and must be provided to initiate any traffic control activities.

B. Signs, Signals, And Devices:

1. Post Mounted and Wall Mounted Traffic Control and Informational Signs: Per CDOT Standards.
2. Traffic Cones and Drums, Flares and Lights: Per CDOT Standards
3. Flagperson Equipment: Per CDOT Standards.

C. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

D. Flares And Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

E. Traffic Signs And Signals:

1. Provide, operate, and maintain traffic control signs to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.
2. Relocate as Work progresses, to maintain effective traffic control.

F. Removal:

1. Remove equipment and devices when no longer required.
2. Repair damage caused by installation.

1.6 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

B. Lock gates as required to prevent access to courts when damage may result from foot traffic on future play surface

C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.7 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.8 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise from and noise produced by construction operations.

1.9 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.10 NOTIFICATION OF PUBLIC

A. Notify public with a sign at each gate with court closure dates 1 week prior to start of construction.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Product delivery requirements.

C. Product storage and handling requirements.

D. Product options.

E. Product substitution procedures.

1.2 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. Provide off-site storage and protection when site does not permit on-site storage or protection.

E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

G. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for Substitutions during bidding period to requirements specified in this section.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for Substitution as for specified product.
3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:

1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
3. Engineer will notify Contractor in writing of decision to accept or reject request.

END OF SECTION

SECTION 01700

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Demonstration and instructions.

D. Protecting installed construction.

E. Project record documents.

F. Product warranties and product bonds.

G. Maintenance service.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete and ready for Engineer's review.

B. Provide submittals to Engineer required by authorities having jurisdiction.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

A. Clean site; sweep paved areas, rake clean landscaped surfaces.

B. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of final inspection.

B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

1.5 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Prohibit traffic from landscaped areas.

1.6 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
2. Field changes of dimension and detail.
3. GPS coordinates of all manholes.
4. Details not on original Contract drawings.

G. Submit documents to Engineer with claim for final Application for Payment.

1.7 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time of Submittals:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.8 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections during warranty period.

B. Examine system components at frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.

D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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Appendix A

Material Product Sheets

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ENVIRONMENTAL COATINGS LLC PRODUCT DATA SHEET

May 1, 2017

SEWER SHEILD® 150 SPRAYABLE

Part of Sewer Shield ® Systems – Low Modulus Acid Protection Lining

Product Description

Sewer Shield ® 150 Sprayable is the next generation of 100% solids, solvent free, low odor, environmentally friendly, epoxy liner system. It is impervious to a wide variety of acids, caustic solutions, oils, grease and many other chemicals. Sewer Shield ® 150 Sprayable is particularly resistant to Sulfuric Acid up to concentrations of 50%. Sewer Shield ® 150 Sprayable is a low modulus lining which provides improved tolerance to thermal cycles and impact resistance.

Uses

Sewer Shield ® 150 Sprayable is used as a lining system for protection against chemical attack to manholes, lift stations, headwork, sewer pipes, grit chambers, clarifiers, wastewater and containment areas, walls, sumps, trenches and pits. Due to the low modulus and environmentally friendly nature, it is ideal for use as a protection system in the wastewater and chemical industries.

Surface Preparation

Concrete: Sandblast to a SSPC-SP13 / NACE 6
Steel: Sand blast to a SSPC-SP 10 / NACE 2

Available Colors

Standard: Ivory (Beige)

Application

Applies to Inside or Outside Containment Areas

Concrete and steel must be structurally sound, dry or damp, free of grease, oils, coatings, dust, curing compounds and other contaminants. Surface laitance must be removed. The preferred method of surface preparation is abrasive blasting or shot blasting creating a texture of 60 grit sandpaper or better. SSPC-SP 13 NACE No.6 joint standard should be followed. For oil contaminated surfaces using steam cleaning in conjunction with strong emulsifying detergent may be considered. Rinse thoroughly with potable water. After cleaning, remove defective concrete, honeycombs, cavities, joint crack voids and other defects by routing to sound material. Smooth, precast and formed concrete surfaces must be cleaned, roughened and made absorptive by abrasive blasting or shotblasting. If it is not possible to abrasive blast or shotblast, acid etching with a 15% Hydrochloric acid solution is permissible. After etching pressure wash or flush the surface with copious amounts of water to neutralize the surface. Care must be taken to ensure that all salts and residue from the reaction have been removed. The pH of the surface should be checked as per ASTM

D4262 following acid etching. Following surface preparation, the cleaned surface should pull concrete when tested with an Elcometer or similar pull tester (ASTM D4541). Before application of the lining system, use the "Visqueen test" (ASTM D4263) to evaluate moisture level in concrete.

Old Concrete

For quick, small patching use suitable epoxy mortar; for larger areas, use C-120 cementations patching material.

New Concrete

Should be allowed to cure for a minimum of 28 days. (Consult manufacturer if earlier times are required). Remove any surface hardener or curing compounds, by using the recommended mechanical methods for surface preparation. Prepare surfaces as recommended above.

Coverage

Coverage rates are approximate and for estimating purposes only. Surface temperature, porosity, and texture will determine actual material requirements.

Recommended:

40-80 mills DFT
20 Sq Ft per gallon @ 80 mills
40 Sq Ft per gallon @ 40 mills

.

Packaging and Mixing

Sewer Shield ® 150 Sprayable is available in pre-measured, pre-proportioned kits. Pour the entire contents of Part B, Hardener into the Part A, Base and mix thoroughly with a low speed drill and a “Jiffy” mixer paddle. Mix for a minimum of 3 minutes. Scrape the sides and bottom of the mixing container (including the paddle of the mixer) during mixing. If the paddle is too small or equipment is not adequate it will not give a uniform mix and an incomplete cure will result together with wet spots. Over mixing with a high-speed drill will shorten the pot life as well as introduce excess air into the mix. Mix only enough material that can be used within the working life.

Sewer Shield ® 150 Sprayable is available in 100 GALLON and 500 GALLON KITS.

Property	Specification
Mix Ratio by Vol	1:1
GEL Time, 150 grams	15-25 Minutes
ASTM D4541, 7 Day Bond Strength (Tensile) Bond to Damp Concrete	Concrete Failure
ASTM D695, 7 Day Compressive Strength (Neat)	2,100
ASTM D638 Tensile Strength (Neat)	1030
Elongation at Break	38%
ASTM C413	<0.04%
VOC	0 Grams/ Liter

Data presented are typical laboratory values.

Storage

50-90 degrees F. Protect from moisture and freezing. Shelf Life: Two years in original, unopened containers, properly stored.

Clean-Up Instructions

Clean tools and application equipment immediately after use with methyl ethyl ketone or xylol. Clean spills or drips while still wet with solvent. Dried material will require mechanical abrasion for removal.

Technical Service

For application procedures or surface conditions not specified above, please contact our office directly.

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ENVIRONMENTAL COATINGS LLC
4702 E. Virginia Street. • Mesa, Arizona 85215-9101
PHONE (480) 984-7608 • FAX (480) 380-4461

C-120 CEMENT UNDERLAYMENT and PATCHING MATERIAL

PRODUCT DESCRIPTION: C-120 Cement is a specially formulated, fast setting, volume stable, calcium aluminate cement based concrete and masonry patching material requiring only the addition of potable water for mixing. C-120 Cement may be used interior or exterior, above or below grade on vertical, horizontal and overhead surfaces without forms. After initial set, C-120 Cement may be shaved to the contours of the surrounding area. C-120 Cement is used to repair and protect against biogenic corrosion to manholes, wet wells, lift stations, concrete pipe, and waste water treatment plants. C-120 has high resistance to sewage, extraordinary abrasion resistance and strong resistance to biogenic corrosion by hydrogen sulfide (H_2S) and sulfuric acid (H_2SO_4) found in waste water environments. C-120 Cement incorporates proprietary fumed densifying agents enhancing the product's ability to resist moist acidic conditions allowing for prolonged life of finished surfaces. High alkalinity of C-120 mortars will provide good rust protection. Also, excellent for the repair and protection of sidewalks, driveways, expressways, ceilings, walls, curbs and panels. C-120 Cement may be used for applications under constant moisture contact.

BENEFITS: RAPID SETTING…NON-SHRINK…NO ADDED CHLORIDES…SHAPEABLE… SHAVEABLE… USE IN THIN TO THICK LAYERS…TENACIOUS BOND… RESISTANT TO FREEZE THAW…LIGHT COLOR.

COMPOSITION: Cement and selected aggregates

TECHNICAL DATA:

Setting Time: ASTM C-403	
Initial Set:	10 to 15 minutes
Final Set:	15 to 20 minutes
Yield Per 50#	0.50 cubic feet

	Compressive Strength: ASTM C-109	Split Tensile ASTM C-403	Shear Bond ATSM C-882
1 DAY	5200 psi		
3 DAYS	5950 psi		
7 DAYS	6100 psi	424 psi	4210 psi
28 DAYS	7850 psi	674 psi	6530 psi

Freeze-Thaw Durability Factor: ASTM C-666 @ 300 Cycles:	97.92

DIRECTIONS FOR USE: All areas to be patched shall be clean and free of oil, grease, dirt, deteriorated concrete and all contaminates. Undercut the edges of the area to be patched to accommodate the repair. C-120 Cement used to repair vehicular traffic bearing areas should be placed a minimum of 1.5" in depth. Clean and prime any exposed steel and reinforcing. Abrade or acid etch slick surfaces to ensure proper bond. When the temperature is above 40^{O} F, pre-wet the prepared area with potable water before applying C-120. Any excess water should be blown or swept away to prevent dilution of the material.

C-120 Cement will require 3.25 to 3.5 quarts of potable water per 50 pound bag to achieve the proper mix consistency. Add the measured amount of C-120 to the proper amount of clean water and mix to a stiff putty like consistency for no more than four minutes. Mix small quantities of C-120 in a clean container with a hand trowel or in a wheelbarrow with a mud hoe. Use a rotary mixer with rubber tip blades for mixing larger quantities, up to 90 lbs. In deep areas over 2", C-120 may be extended with up to 25 pounds of clean, washed gravel per 50 pound bag for filler. Do not mix more material than can be placed in five minutes. Do not re-temper with additional water.

Place C-120 Cement immediately after mixing. Force C-120 firmly into the area to be patched by hand or with a trowel and mold to the desired shape. Compact thoroughly to ensure bond. After initial set, finish C-120 with a steel trowel until smooth and level with the surrounding surface. Do not overwork the material. Cure C-120 Cement with damp cure method if any surface treatment will be used. Curing is mandatory especially in hot weather, direct sunlight and for thin patches.

CAUTIONS: Mix C-120 no more than four minutes. Do not mix more material than can be placed in five minutes. Use only potable water for mixing. Do not over water. Excess water does not improve workability. Do not re-temper. Clean mixing equipment between batches. Do not apply to frozen or frost filled surfaces. Do not apply during freezing weather. Contains cement, avoid inhalation of dust. Wear gloves during the mixing and placement of material.

PACKAGING: Fifty (50) pound (22.7 kg.) multiwall bleached paper bags. Fifty bags per pallet (2,500 pounds per pallet)

STORAGE: 40^{O} to 90^{O} F

SHELF LIFE: 1 year in original unopened package properly stored. Store in a dry location. Do not lay bags directly on cement surfaces.

FREIGHT CLASS: Class 50

LIMITED WARRANTY: This product is warranted to be of merchantable quality when used according to the instructions herein. It is not warranted to be suitable for any purpose or use other than the general purpose for which it is intended. Liability under this warranty is limited to the replacement of the product as purchased, if found to be defective upon inspection by the manufacturer. This limited warranty is issued and accepted in lieu of all other expressed warranties and explicitly excludes liability for consequential damages. Buyer assumes all risk and liability resulting from the use of this product.

Information presented herein has been compiled from sources considered dependable and is accurate and reliable to the best of our knowledge and belief, but it is not guaranteed to be so. Nothing herein is to be construed as recommending any practice or any product in violation of any law or regulation. It is the user's responsibility to determine the suitability of any material for a specific purpose and adopt necessary safety precautions. We make no warranty as to results to be obtained in using any material and, since conditions or use are not under our control, we must necessarily disclaim all liability with respect to use of any material supplied by us.

Revised July 2004

Appendix B

Piezometer Results

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Four piezometers were installed during the design process to track ground water depth. The table below summarizes this information.

Piezometer Vicinity	Depth of Ground Water (ft)												
	4/5/2024	5/13/2024	6/12/2024	7/12/2024	8/12/2024	9/10/2024	10/16/2024	11/12/2024	12/13/2024	1/15/2025	2/14/2025	3/14/2025	3/26/2025 (Test Hole)
35.5 Rd	16.5	11.5	9.9	10.4	10.1	10.3	10.5	12	12.8	13	11.9	11.8	-
Canal Crossing (36 1/4 RD)	11.0	5.3	9.8	7.1	6.6	7.4	7.3	9	9.4	9.7	9	9.1	-
Lift Station (35 RD)	15.5	13.1	11.2	11.3	10	9.2	9.8	11.4	13.1	14.3	14.6	15	15
F and 34 Rd	8.3	8.3	8.9	9.3	8.8	9.1	9.2	8.7	8.5	8.8	8.7	8.8	-

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Appendix C

Lift Station Test Excavation

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A test excavation was performed at the proposed lift station site, with the soil conditions documented below:

Excavation Notes:

- Dry topsoil
- Soil appeared more moist/claylike at 6 ft
- Very moist/soft/claylike at 11 ft
- At 15 feet there was minor sluffing/collapse from forward and aft of trench, sidewalls remained stable
- Final depth 21.5 ft, sidewalls stable
- At 21.5 ft, began quickly filling with water



3’ Depth



6′ Depth



15′ Depth



18’ Depth



21.5′ Depth

TECHNICAL SECTION 2: SITEWORK
(START TO STA. 127+05 AND STA. 127+90 TO END)

FOR

Town of Palisade, Colorado
Sewer Transfer Line

December 2025

Prepared by: J-U-B Engineers, Inc.
81-23-029

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SECTION 100 – GENERAL

100.1 Description

These specifications include material specifications and construction requirements for underground sewer systems installed in the Mesa County right-of-way, CDOT right-of-way, and in other areas under Town jurisdiction or ownership.

The standards do not include all specifications for use on public works projects due to many specialized applications. They are intended to encompass construction typical to most residential projects.

Although this document and details have been prepared and reviewed by Professional Engineers and, as such, should be considered as applicable for most standard construction without further revisions, they are not intended to eliminate the need for the involvement of a Registered Professional Engineer on a specific project. The Registered Professional Engineer, when referencing the documents for a specific project is responsible for insuring the specifications and drawings are appropriate for the specific use.

Not all possible requirements are included in the Standards. Should additional or revised requirements be desired, the items should be included under the Special Provisions and Special Technical Provisions in the Contract Documents for the project.

100.2 Specification Modifications

Portions of these specifications may be modified or deleted by appropriate items in the project Special Provisions. All other modifications and deletions shall be approved by the Town Engineer or Town Representative.

100.3 Revisions of Standards

When reference is made to ASTM, AWWA, AASHTO, or other specifications or methods, it shall be understood to mean the latest edition or revision of said specification, as amended and issued at the time of the Advertisement for Bids.

100.4 Special Provisions

(Add here if necessary)

100.5 Definitions

The following abbreviations are used in these specifications:

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
AWWA	American Water Works Association
CDOT	Colorado Department of Transportation
OSHA	Occupational Safety and Health Administration
NACE	National Association of Corrosion Engineers

SECTION 101 – QUALITY CONTROL AND QUALITY ASSURANCE

101.1 Quality Control

The Contractor is responsible for quality control of all work performance and shall implement whatever procedures, methods, testing, surveying and supervision that are required in order to ensure that the Work conforms to the Construction Plans and Contract Documents.

101.2 Quality Assurance

The Contractor shall provide a quality assurance program. This program shall include systematic inspection and testing of the work and materials during construction to assure the Owner and the Town that the Contractor is providing work that is in conformance with the Town approved plans and specifications. Minimum quality assurance testing requirements for underground utility construction are given in Table 101.

Table 101 – Required Quality Assurance Testing

Test Required	Test Procedure	Required or Allowed Range	Minimum Test Frequency
Compaction of bedding and haunching materials (except crushed rock)	AASHTO T 99 and T 310	90% minimum at ±2% of optimum moisture	1 per 400 L.F. of trench (and each branch or section of trench less than 400 feet in length) for each two-foot vertical depth of backfill material
Trench compaction to sub grade 1. Within right of way 2. In unimproved areas outside of right of way or within landscaped areas	AASHTO T 99 and T 310	 95% minimum at ±2% of optimum moisture Match existing or 90% minimum	
Compaction of aggregate base course material	AASHTO T 180 and T 310	95% minimum at ±2% of optimum moisture	1 per 200 S.Y.
Compaction within 24” of all structures (manholes, catch basins, vaults, etc.)	AASHTO T 99 and T 310	95% minimum at ±2% of optimum moisture	3 per each two-foot vertical depth of backfill material
Compaction of soil within canal walls	AASHTO T 99 and T 310	95% minimum at -1%/+3% of optimum moisture	1 per 200 L.F. of canal wall

SECTION 102 – MATERIALS

102.1 Description

This section covers pipe and other materials to be used in the construction of the various types of underground utilities. All materials used shall be new and in conformance with the applicable standards.

102.2 Contractor Requirements

All materials to be furnished by the Contractor shall conform to the requirements of these specifications. The type, size and strength class of pipe, fittings and other materials shall be as shown on the Construction Drawings or otherwise specified in the Contract Documents.

102.3 Town Furnished Materials

When the Town furnishes materials that are to be incorporated into the Work by the Contractor, provisions will be made in the Special Conditions as to the responsibilities of the Town and the Contractor regarding delivery, unloading, storage, and protection of the materials.

102.4 Inspection and Testing

All pipes shall be tested in conformance with the applicable standards. Testing may be witnessed by the Town Representative, or by an approved independent testing laboratory. Upon request of the Town, the Contractor shall provide a copy of certified test reports indicating that material does conform to the applicable standards or specifications.

102.5 Handling

All materials shall be handled with equipment and methods adequate to prevent shock or damage. Under no circumstances shall materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground. If any part of the coating or lining is damaged, the Contractor shall repair or replace the material at his expense as directed by the Town. All pipe and appurtenances shall be handled in accordance with the appropriate AWWA and ASTM standards.

102.6 Storage

The Contractor will be held responsible for the safe storage and protection of all pipe and other materials delivered to the work site. The interiors of all pipe and fittings shall be kept free from dirt and foreign matter at all times. Gaskets for pipe joints shall be stored in a cool location out of direct sunlight.

If sunburned pipe is utilized, the Town requires that the Contractor provide a manufacturer's certification that all warranties are still valid. The Town reserves the right to reject sunburned pipe depending on the severity of the apparent damage.

Any material that has been damaged before actual incorporation in the Work shall be repaired or replaced at the Contractor's expense.

102.7 PVC Pipe and Fittings for Construction.

Pipe used in construction of gravity sanitary sewer mains and service lines shall be polyvinyl chloride (PVC). Sanitary sewers and waterlines under pressure shall be PVC pipe.

The minimum pipe size for gravity sewers shall be eight-inch (8") diameter for mains and laterals, and four-inch (4") diameter for service lines unless otherwise approved.

Service taps for new sewer construction shall be accomplished utilizing full body wye fitting. For taps into existing clay, concrete, or PVC sewer lines, "Inserta Tees" manufactured by Inserta Tee of Forest Grove, Oregon (503/357-2110) or approved equal will be used in accordance with manufacturer's specifications. The Town or its representative will inspect the clay or concrete sewer main prior to installation of the Inserta Tee to ensure the pipe and proposed tap location are viable. Tapping into clay, concrete or PVC will be accomplished by using a hole cutting saw capable of making one clean hole in accordance with the manufacturers recommended size based on type of pipe. It is not acceptable to use a hammer and chisel to make tap holes.

102.7a PVC Gravity Sewer Pipe

PVC sewer pipe and fittings shall conform to ASTM D3034 Type PSM for diameters 4" to 15" and to ASTM F679 Type I for diameters 18" to 27". The minimum wall thickness for PVC pipe shall conform to Standard Dimension Ratio (SDR) 35. Joints shall be bell-and-spigot type with flexible electrometric seals conforming to ASTM D3212 and shall not be longer than 14 feet in length. Gaskets shall be neoprene or other synthetic rubber material conforming to ASTM F477. The bells shall be integrally formed with the pipe or fitting.

Ribbed PVC pipe may be used for sizes 15" through 30". Ribbed PVC sewer pipe shall be seamless open profile and meet the requirements of ASTM F794 and Uni-Bell UNI-B-9. Pipe shall have a smooth interior with a solid cross-sectional rib exterior. Exterior ribs shall be perpendicular to the axis of the pipe to allow placement of the sealing gasket without additional cutting or machining. The pipe stiffness shall be a minimum of 46 psi when tested at 5% deflection in accordance with ASTM D2412.

102.7 b PVC Pressure Pipe

PVC pipe used for use under pressure shall meet the requirements of ASTM D2241 (IPS) or AWWA C900. Joints shall conform to ASTM D3139 and have elastomeric seals conforming to ASTM F477. The type and pressure class shall be as shown on the Construction Drawings or otherwise specified.

Fittings. PVC pipe fittings shall be fabricated of PVC material having a pressure rating equal to or greater than the pipeline used. PVC fittings may be used only with PVC pipe. When used with AWWA C900 PVC pipe, sizes 4" through 12", the PVC fitting shall conform to AWWA C907. When used with ASTM D2241 pipe, the PVC fitting shall be of the same or higher class as the pipe and the pipe rating shall be reduced by 50%. Fittings shall be fusion bonded epoxy coated on interior and exterior surfaces in accordance with AWWA C116.

102.8 Manholes for Sanitary Sewers

Manholes shall be constructed in accordance with Standard Drawings at the end of these specs.

Cement. All cement used in mortar, concrete bases, and precast manhole riser sections, cones and flat tops, for sanitary sewer manholes, shall be Type V or modified Type II Portland cement having less than five percent (5%) tricalcium aluminate.

Precast concrete manholes bases shall be required unless prior approval from Town Representative.

Precast Concrete Manhole Sections. Manhole risers, cones, flat tops and grade rings shall be precast reinforced concrete sections conforming to ASTM C478 or AASHTO M 199. Manhole risers, cones and flat tops shall be made with tongue and groove ends for continuous and uniform joints between sections. The joint sealant shall be a flexible preformed, bitumastic joint sealant.

Polymer Concrete Manholes. Polymer Concrete Structural Manhole risers, cones, flat lids, grade rings shall be designed by manufacturer to meet the intent of ASTM C 478 with allowable compositional and sizing differences as designed by the polymer concrete manufacturer.

1. AASHTO HS-20 design or as required loading applied to manhole cover and transition and base slabs
2. Polymer manholes will be designed based upon live and dead load criteria in ASTM C 857 and ACI 350-06
3. Reinforcement – Shall use acid resistant reinforcement (FRP Bar) in accordance with ACI 440.1R-06 as applicable for polymer concrete design
4. Polymer Concrete Mix Design shall consist of thermosetting resin, sand, and aggregate. No Portland cement shall be allowed as part of the mix design matrix. All sand and aggregate shall be inert in an acidic environment

Manhole Waterproofing. Manhole waterproofing is required for the exterior surface of base, riser sections, cone, and invert, and shall be coated with minimum 10 mil. coal tar epoxy. Waterproofing may be field-applied.

Corrosion Protection. All precast concrete manholes shall be coated on the interior surfaces of the riser and cone with a minimum 80-mil. Sewer Shield 150 or approved equal. Coating is to be shop-applied to concrete after concrete has cured 28 days or steam cured over a 24-hour period or as required to meet the 28-day strength requirements. Manhole seams shall be field coated after installation.

Prior to applying coating, concrete must be prepared and meet NACE No. 6/SSPC-SP 13 requirements. Concrete must be free of bug holes or voids. Where bug holes or voids can't be removed, fill prior to application of coating using C-120 Cement Underlayment. Mixing method, rates, and air surface temperature during application and curing shall be performed per manufacturer's recommendations. Coating material shall be mixed in a clean dry container free of foreign matter or debris.

Apply coating in accordance with the manufacturer's recommendations and allow to dry and harden prior to transporting precast sections to the project. The Contractor shall be responsible for the repair of any malformations in the rehabilitation prior to acceptance by the Town.

The Contractor is responsible for ensuring warrantee conditions are met for approval of manufacturers 5-year warrantee. These conditions include, but may not be limited to, providing NACE/AMPP CIP Level 3 certified inspector to perform hold point inspections for surface prep, underlayment inspection, and holiday inspection to confirm proper application. Inspection reports (using Environmental Coatings template) must be filled out by inspector and submitted to Environmental Coatings for approval. Holiday test shall be performed using High

Voltage Holiday Testing at 100 volts per mil. Contractor shall coordinate these inspections with the Town a minimum of 3 days prior to performing them to allow the Town to observe the testing.

All final inspections of the coated manholes shall be submitted to the Town for review prior to issuance of final payment.

Manhole Steps. Steps are required in sanitary sewer manholes only unless otherwise shown or specified in the Contract Documents. Manhole steps shall be manufactured from copolymer polypropylene plastic with ½" diameter, Grade 60 steel core. The steps shall be set in the wall of the manhole riser at the time the riser is manufactured. For precast manhole bases with integral riser sections, the steps shall be installed at a 45-degree angle from the inlet pipe. The spacing between steps shall be such that when the manhole components are assembled the spacing is in conformance with OSHA Standards.

Pipe-to-Manhole Connector. Pipe-to-manhole connectors shall be manufactured with rubber conforming to ASTM C923. All metal components shall be stainless steel.

Rings and Covers. Manhole rings and covers shall be cast iron dipped in an asphalt-based material to resist rusting. The standard Town manhole shall be Castings MH-250-24 C.I. or approved, fully interchangeable substitute. The bearing surfaces between the ring and cover shall be machine finished or ground to assure non-rocking fit in any position and interchangeability. The cover shall have a beveled pick hole that has a width of ¾" at the top and 1" at the bottom. The length of the pick hole (along the circumferences of the lid) shall be at least 1 ½". The word SEWER shall be cast in the cover.

Inverted rings and covers will NOT be allowed unless approved by the Town representative.

Watertight Manhole Covers. Where a watertight manhole is required, the ring and cover shall be equipped with a gasket or o-ring, the cover shall have no holes that could allow the intrusion of water into the manhole, the ring and cover shall be drilled and tapped at 120 degree spacings and 3 stainless steel bolts (Grade 316) shall be furnished to secure the cover to the ring. Anti-seize compound will be applied to threads PRIOR to installation.

The standard ring and cover for watertight manholes shall be Castings MH-250-24 C.I. with Cover D, bolted and gasketed or approved equal.

Cast Iron-Grade Rings. Under no circumstances will cast iron grade rings be permitted for new construction. Cast iron grade rings that fit in the top of existing manhole rings shall be the same diameter as the existing ring and shall have three set screws for attachment to the existing ring. The maximum height of a grade ring shall be 4".

102.9 Concrete and Mortar

All concrete used in construction of manholes, inlet boxes, vaults, concrete encasements, thrust blocks, etc., shall meet the requirements of the Standard Specifications for Road and Bridge Construction, Class B. Unless otherwise specified, all concrete shall be made with modified Type II Portland cement.

Cement mortar used in construction or maintenance of manholes, inlets, vaults, etc., shall be a non-shrink grout conforming to ASTM C109 and ASTM C191.

Rapid-Road Repair grout or approved equal is recommended for setting the ring and cover on top of the concrete grade rings. All-Crete 5 Minute Set (Fostroc, Inc., Georgetown, KY) or approved equal is recommended for invert work.

Annular space grout mix for cased pipe sections shall be a low density (cellular) grout mix, unless otherwise approved by project manager. Grouting plan must be submitted to Engineer prior to grouting. This plan shall include methods to prevent pipe buoyancy. Failure to avoid buoyancy affect on pipe flowlines or connections will require the removal and reinstallation of sanitary sewer within casing.

102.10 Reinforced Concrete Pipe

Reinforced Concrete Pipe (RCP) shall be manufactured in accordance with one of the following standards:

ASTM C 76 or ASTM C 655 - RCP (designed for specific D-loads).

ASTM C 507 - Reinforced Concrete Elliptical Pipe

ASTM C 506 - Reinforced Concrete Arch Pipe

ASTM C 361 - Low Head Concrete Pressure Pipe - All Concrete Pipe shall meet the requirements of this standard

Reinforced concrete pipe shall be made with Type V cement or other approved cement having less than 5% tricalcium aluminate. RCP shall not be used where the pH of the soil is less than 5.

Joints. RCP joints shall be manufactured with flexible watertight joints conforming to ASTM C443 unless otherwise specified or approved by the Engineer. Non-watertight joints, when approved, shall conform to ASTM C 990.

102.11 Water Service Connection

Ute Water will be completing water service work for the lift station between the water main and meter. This includes the tap, water service line within ROW, meter pit, and meter assembly. Contractor will be responsible for the following:

1. All water service work between the meter pit and lift station. Water service pipe shall be SCH 40 PVC and have a minimum depth of cover of 48”. Connection at meter will be 1½-inch brass male iron pipe thread.

2. Ute Water requires a minimum of 60 days notice prior to performing this work, which Contractor is responsible for coordinating

3. Surface restoration for water service.

4. Traffic Control support for water service installation.

The installation of water services shall be installed per Ute Water Conservancy District standards for all services east of 95+75, and Clifton Water District standards for all services west of 95+75. Contractor to coordinate this work with water service provider.

SECTION 103 – REMOVALS, EXCAVATION, BACKFILLING AND RESTORATION

103.1 Description

For the purpose of this section, underground conduits shall be considered sanitary sewers, storm drains, water mains, irrigation lines or any other underground pipeline. Wherever the term “pipe” and “pipeline” is used, it shall mean underground conduit.

This section covers surface removals, excavation, backfilling, compaction, disposal of surplus material, restoration of disturbed surfaces, and all other work required for the safe and proper construction of underground conduits.

103.2 Survey Line and Grade

All construction surveying and staking shall be performed by or under supervision of a professional engineer or land surveyor registered in the State of Colorado. The Contractor shall use a laser instrument to maintain and control the line and grade of all gravity flow pipelines including sanitary sewers, storm drains and irrigation lines. Check points shall be set at 25 feet, 50 feet, 100 feet and 200 feet from the beginning of each reach of pipe to assure that the laser is on the correct line and grade.

103.3 Removal of Structures and Obstructions

The removal of structures and obstructions shall be in accordance with Section 202 of the CDOT Standard Specifications for Road and Bridge Construction. The Contractor shall remove surface materials and obstructions only to the widths necessary for excavation of the trench. All trees, shrubbery, fences, plantings and structures not designated for removal shall be protected, or if moved, restored to their original condition after construction is complete. Removal of concrete curbs, gutters, sidewalks, driveways, and asphalt pavement shall be along existing joints or neatly cut lines.

All vegetation, concrete, and other refuse removed from the construction limits, shall be separated from suitable topsoil and backfill material and hauled to a disposal site secured by the Contractor and approved by the Town unless otherwise specified in the Contract Documents. The Contractor shall inform the Town in writing of the location where any asphalt pavement removed from the project site will be disposed.

Removed asphalt pavement shall be hauled to a designated site that is approved or specified in the Contract Documents. Asphalt millings shall be separated from asphalt pavement not removed by milling (planing) and both materials placed in appropriate stockpiles.

Where the trench is in an unpaved area, clean topsoil suitable for final grading shall be stripped, stockpiled separate in approved locations, and restored to the original thickness after the trench is backfilled.

103.3a Clearing and Grubbing

Work consisting of clearing, grubbing, removing, and disposing of vegetation and debris within the limits of the right of way, easement areas, borrow pits, and other areas required for completion of the work shall be performed in accordance with Section 201 of the CDOT Standard Specifications for Road and Bridge Construction.

103.3b Asbestos and Asbestos Abatement and Removal

The Contractor shall be responsible for the removal of all asbestos containing materials (ACM) encountered during construction. All asbestos pipe encountered during construction shall be removed and disposed of, even if removal is not necessary to install the proposed waterline. Materials potentially contaminated with asbestos shall be disposed as asbestos waste. Non-ACM will not be paid as asbestos waste.

The Contractor shall assume full responsibility and liability for complying with all applicable federal, state, and local regulations pertaining to work practices, hauling, disposal, certifications, and protection of workers, visitors to the site, and persons occupying areas adjacent to asbestos abatement activities. The Contractor is responsible for providing medical examinations and maintaining medical records of personnel if required by the applicable Occupational Safety and Health Administration (OSHA) regulations. The Contractor shall hold the Town of Palisade and J-U-B harmless for failure to comply with any applicable work, hauling, disposal, safety, health, or other regulations on the part of the Contractor, the Contractor's employees, or subcontractors. Where conflict between the regulations and this scope of work document exists, the most stringent requirements shall be followed.

The following special considerations shall be followed by the contractor during ACM removal activities.

1. Polyethylene sheeting shall be affixed in a manner that will ensure it will remain in position throughout the length of the project. Any tears in the polyethylene sheeting shall be immediately repaired. Ensure any additional disposal site requirements for their acceptance are applied.

2. The Owner or Owner's Representative will not attempt to enforce compliance with the specifications or applicable federal, state, or local regulations; however, the Owner or Owner's Representative reserves the right to stop asbestos abatement work when observed work practices are not in compliance with such laws, regulations, and requirements. Safety of the project area for the protection of the Contractor and the general public is the responsibility of the Contractor. The Contractor is solely responsible for evaluating compliance with all applicable laws and regulations.

3. The quantities identified herein are approximate. The Contractor is responsible for verifying material quantities and site conditions. Any discrepancies or omissions must be brought to the attention of the Owner's Representative prior to submitting a bid. By submitting a bid, the Contractor agrees with all conditions for completing the work including general work areas, quantities, schedules and procedures.

4. If applicable, the Contractor shall be responsible for acquiring permits from the CDPHE.

5. The Contractor shall also comply with other requirements specified in EPA, OSHA, state, and local requirements and regulations.

6. Contractor to provide documentation that pipe has been disposed of appropriately.

103.3c Piezometer Abandonment

Piezometers shall be abandoned using one of the following methods:

1. Filling the well to the static water level with drill cuttings, clean sand or clean gravel, then with clean native clays, cement or high solid bentonite grout to the ground surface. The

uppermost five (5) feet of casing shall be filled with grout or a permanent watertight cover shall be installed at the top of the casing.

2. Removing all casing that was installed and by filling the hole(s) with drill cuttings, clean native clays, cement or high solid bentonite grout to within five (5) feet of the ground surface. The top five (5) feet of the hole shall be filled with materials less permeable than the surrounding soils that are adequately compacted to prevent settling.

Static water level can be found in associated Geotech report. Assume casing installed to full depth of bore.

103.4 Bracing and Sheeting of Trenches

All trenches shall be properly braced, sheeted or otherwise supported to provide safe working conditions and protection of the Work, workers and adjacent property. Bracing, trench shields and sheeting shall conform to the recommendations in the Occupational Safety and Health Standards for Construction (OSHA). Unless otherwise approved, all trench support materials shall be removed in a manner that will prevent caving of the sides and movement or other damage to the pipe.

103.5 Trenches with Sloping Sides

Where working conditions and right-of-way and easement width permit, trenches in unimproved areas may be excavated with sloping sides in accordance with OSHA requirements. All soils shall be assumed to be OSHA Type C Soil, unless otherwise classified by a qualified soils technician. Trenching and other excavations shall not extend beyond existing easements, right-of-way or limits shown on the Construction Drawings unless otherwise approved by the property owner and the Engineer.

Where trenches with sloping sides are permitted, the slopes shall not extend below a point 12 inches above the top pipe. The trench shall be excavated with the vertical sides below this point with widths not exceeding those specified on the Standard Drawings.

In streets, alleys or narrow easements, trenches shall be excavated with vertical sides, properly braced and supported, unless otherwise approved by the Engineer.

103.6 Open Excavation Limits

The length of open trench shall be kept to a minimum and shall not exceed the length necessary to accommodate pipe laying and backfilling operations unless otherwise approved by the Engineer. The Contractor shall be responsible for covering or barricading unattended trenches and excavations as necessary for protection of the public and the Work. All trenches and excavations shall be backfilled at the end of each workday, unless otherwise shown on the plans or approved by the Engineer. The end of a trench may be left open overnight if the entire perimeter of the excavation is fenced, lighted and barricaded with construction equipment and/or Jersey barriers. No traffic lane shall be blocked by an open excavation, piece of equipment or other obstruction without a proper lane closure, road closure or other approved traffic control.

103.7 Unauthorized Excavation and Pavement Removal

Unless authorized by the Engineer, all removed pavement and excavations made beyond the lines and grades shown on the Construction Drawings or described in the Contract Documents shall be replaced at the Contractor's expense.

103.8 Unstable Trench Bottom

Where the excavation is found to consist of muck, organic matter or any other material that is determined, by the Engineer, to be unsuitable for supporting and maintaining the line and grade of the pipe, the trench shall be excavated to an additional depth as agreed upon by the Contractor and Construction Inspector/Engineer, and replaced with an approved granular stabilization material. Should the Contractor and Inspector/Engineer fail to reach an agreement as to the depth and/or method of trench foundation stabilization, the Town may secure or require the Contractor to secure the services of a Geotechnical Engineer to assist in determination of an appropriate method for stabilization.

103.9 Bedding and Shaping Trench Bottom

Unless otherwise directed or specified in the Project Documents, all trenches shall be excavated to at least six inches (6") below the pipe grade and backfilled to grade with approved granular bedding material. The bedding material shall be hand shaped and graded until the trench bottom is uniform and free from rocks, bumps, and depressions. A coupling or bell hole shall be dug at each pipe joint with sufficient length, width and depth to permit assembly of the joint and provide a minimum clearance of two inches (2") between the coupling and the trench bottom.

After the pipe is joined, pipe-bedding material shall be placed and tamped under each pipe joint until all voids are filled. Care shall be taken not to displace the pipe from its line and grade.

103.10 Cutoff Walls

Cutoff walls shall be installed along every utility line to inhibit the movement of groundwater through the screened rock bedding. Cutoff walls shall be installed per details provided in Drawings.

103.11 Rock Excavation

Rock excavation shall consist of the removal of boulders or concrete measuring one-half (1/2) cubic yard or more, hard shale, sandstone or other bed rock which, in the opinion of the Engineer, requires for its removal the continuous use of pneumatic tools or drilling and blasting. Rock excavation shall be determined in accordance with Section 203 of the CDOT Standard Specifications for Road and Bridge Construction.

Before payment for rock excavation is approved, the Contractor will be required to demonstrate that the material cannot be removed by hand pick or by power operated excavator or shovel. No payment will be made for rock excavation unless authorized by the Engineer in writing prior to the work being done.

Blasting. Whenever rock excavation is encountered, air or hydraulic hammers or some equivalent method will be used if possible. Blasting shall be used only if other methods have proven unsuccessful and only upon the Engineer's approval.

In addition to the requirements of the General Contract Conditions, blasting will be conducted in accordance with OSHA Regulations Standard 1926 – sub part U, and will be allowed only after the following conditions have been satisfied:

1. One competent experienced person shall be specifically designated in charge of explosives and all related activities. The blaster-in-charge shall carefully supervise all work related to the use, storage, transportation and handling of explosives. The blaster-

in-charge or the Contractor shall select a blasting crew to assist with explosives activities, including transportation and area security. Only the minimum number of competent, experienced personnel, consistent with efficient operation, shall be permitted to handle explosives. Anyone demonstrating carelessness, incompetence, or inexperience shall be excluded from further handling of explosives. The blaster-in-charge shall demonstrate the following minimum qualifications:

a. Proof of a valid Colorado Blaster's License or other license issued by an equivalent licensing body.
b. Written resume showing not less than three years of active involvement as blaster-in-charge on projects similar in scope to the current project.
c. Five references who can testify to the known qualifications and reliability of the proposed blaster-in-charge.

2. The blasting crewmembers shall demonstrate the following minimum qualifications:

a. Completion of at least 24 hours of explosives and blasting safety training.
b. Written resume showing not less than one year of acceptable experience with explosives under a qualified licensed blaster.

3. At least 5 days prior to any blasting, the Contractor shall submit a blasting plan to the Town Engineer or his representative. If unanticipated rock is encountered, the Town may approve starting the blasting in less than 5 days from the submittal of the blasting plan. The blasting plan shall include the following items:

a. A description and license number of the vehicle to be used for transportation of explosives, routes to be traveled and proposed hours of travel, and qualifications of driver.
b. Type of explosives, initiation system, drilling system, loading plan, firing plan, pre-blast and post-blast inspection, handling of misfires and removal and disposal of excess explosives.
c. Proposed signs, guard system, signal system, methods of communication, pre-blast notification of affected agencies or entities and traffic control measuring during blasting.

4. The safety of personnel shall be the primary consideration in decisions involving use of explosives. Protection of vehicles, utilities, and adjacent property from ground motion or fly-rock must also be provided. Use of blasting mats and other protective devices will be required. The Contractor shall retain sole responsibility for repairing or replacing any utilities or property damaged as a result of his blasting operations. Due to the proximity of residences and vehicular traffic, use of controlled blasting techniques is specifically required. A delayed blasting system shall be utilized that will not allow more than two holes to detonate simultaneously. Blasting will only be allowed during times of low traffic on the adjacent roads and only in conjunction with traffic closure for the period of time during which blasting occurs. Traffic closure must be approved by the Town Representative or Town Engineer.

103.12 Stockpiling Excavated Material

Excavated material shall be piled in accordance with OSHA guidelines in locations that will not endanger the Work, create traffic hazards or obstruct sidewalks and driveways. Fire hydrants, valve boxes, manholes and other utility access points shall be left unobstructed. Gutters and other watercourses shall not be obstructed unless other satisfactory provisions are made for runoff and street drainage.

All surplus material and excavated material unsuitable for backfilling shall be removed from the site and disposed of in areas secured by the Contractor.

103.13 Dewatering Trenches

Trenches shall be kept free of water during pipe-laying operations by draining, pumping or other approved methods. The water level shall be maintained at least six inches (6") below the trench bottom throughout the placement of bedding, pipe laying, joining and backfilling operations.

The dewatering shall be carried out so that it does not destroy or weaken the strength of the soil under or along the side of the trench. The method of disposal of trench water shall be approved by the Town Engineer or their representative, and must be run through a filter bag if discharging into the canal, however may not be discharged into the canal at all when canal is full. Watertight plugs shall be installed in the ends of all water and sewer lines when the trench is not being dewatered and shall remain readily available to protect the pipe and downstream appurtenances in the event of unplanned water entering the excavation. Surface water from any source shall be prevented from entering the trench excavation and open ends of the pipe. No additional payment will be made to the Contractor due to an unstable trench or pipe foundation conditions caused by surface water entering the trench.

103.14 Backfilling Pipe and Structures

Unless otherwise specified or approved by the Town Representative or Town Engineer, all backfill material shall be placed with moisture-density control in accordance with the typical trench detail shown on the Standard Drawings. All backfill material shall be adjusted to within two percent (2%) of the optimum moisture content prior to its placement in the trench. Wetting or water soaking trenches to achieve compaction of the backfill will not be permitted except when (1) soil sample tests show that the backfill and excavated trench materials consist of gravel or other granular material having less than 15 percent by weight passing a No. 200 sieve; and (2) the Engineer has given written approval prior to water soaking.

A minimum of 24 inches of compacted backfill shall be placed over the top of all polyvinyl chloride (PVC) and polyethylene (PE) pipes before vehicles or heavy equipment are allowed to pass over the pipe. Less cover may be allowed only where flow-fill or other approved material is used for the pipe haunching and backfill material. Flow-fill shall meet the requirements of Section 206.02(a) of the CDOT Standard Specifications for Road and Bridge Construction.

During initial backfilling, the Contractor shall take all necessary precautions to prevent movement or distortion of the pipe or structure being backfilled. Pipe haunching materials shall be placed and compacted in even lifts of both sides of the conduit to six inches (6") above the top of the pipe. Above the bedding and haunching material, earth backfill material shall be placed full width in uniform layers not more than twelve inches (12") thick. Each layer shall be compacted to the required density with approved mechanical or hand tamping equipment. Hydro-hammers or other heavy compaction equipment shall not be used unless approved by the Town Representative or Town Engineer. No hydro-hammer shall be used for compaction with less than 48 inches of cover over the pipe.

Surface water from any source shall be prevented from entering the excavation. No additional payment or extension of contact time will be made to the Contractor due to saturated or unstable conditions caused by surface water entering the excavation.

All backfill shall be frequently tested to ensure that the required density is being attained. For every 400 lineal feet of trench and each branch or section of trench less than 400 feet in

length, at least one compaction test shall be performed for each two-foot vertical depth of backfill material placed. The first test shall be taken approximately two feet above the top of the pipe and the last test shall be at the pavement sub grade or 6 inches below the ground surface in unpaved areas. Compaction tests shall be taken at random locations along the trench and wherever poor compaction is suspected. If any portion of the backfill placed fails to meet the minimum density specified, the failing area shall be defined by additional tests, if necessary, and the material in the designated area shall be removed and replaced to required density at the Contractor's expense.

The frequency of compaction testing may be reduced to one test for every 1,000 feet of trench if full-time inspection is made during the backfilling operation by the Engineer or an independent testing laboratory and sufficient initial testing has been performed to demonstrate that the methodology being used achieves the required results. The methodology shall be verified for each soil type or trench condition encountered.

It shall be the Contractor's responsibility to make necessary excavations and to provide safe access into the excavations in accordance with OSHA Standards in order to accommodate compaction tests at all locations designated by the Inspector or authorized technician.

Failed compaction tests shall be immediately reported to the Inspector and the Contractor. A summary report of all compaction test results, including retests of failed tests and a test location map or other approved location format shall be submitted to the Town Representative or Project Engineer and to the Contractor. Compaction test results are required as a basis of acceptance of facilities by the Town in accordance with Section 106.1.

Concrete structures shall not be backfilled until the concrete and mortar therein has attained a minimum compressive strength of 2000 psi and can sufficiently support the loads imposed by the backfill. Earth backfill shall be placed simultaneously on all sides of the structure in layers approximately twelve inches (12") thick. Each layer shall be compacted to not less than ninety-five percent (95%) of the maximum dry density determined in accordance with AASHTO T 99.

103.15 Granular Stabilization, Bedding and Haunching Materials

Granular materials required for stabilization of poor sub grade soils, bedding of pipe and structures and haunching around pipe shall meet the gradation requirements shown on the following table.

Sieve Size	Percent Passing, by Weight	
	Pipe Bedding & Haunching (crushed rock)	Granular Stabilization (screened or crushed rock)
2 inch	---	100%
1 inch	100%	---
No. 200	20% maximum	15% maximum

Crushed rock shall be the product of crushing rock and gravel. The portion of the material larger than will pass a 3/8-inch sieve shall contain at least 50 percent (50%) of particles having three or more fractured faces. Not over 5 percent (5%) shall be pieces that show no fractured faces.

103.16 Earth Backfill Material

Earth backfill material shall consist of approved materials developed from project excavations or imported from another source. To be suitable for backfill, earth or earth and rock materials shall be free from muck, frozen lumps, ashes, trash, vegetation and other debris. All

excavated materials which, in the opinion of the Town Representative or Town Engineer, are unsuitable for use in the backfill shall be removed from the site and disposed of by the Contractor at his expense. The maximum size of rock or clod allowed within 6" of any plastic pipe shall be one inch (1"). The maximum size of rock or clod allowed within 6" of a rigid pipe or structure shall be three inches (3").

Testable Materials. Any soil or soil and gravel mixture having at least 70% passing the ¾" sieve and at least 50% passing the No. 4 sieve.

Pit-run Fill. Pit-run, crushed asphalt pavement or other material which is "too rocky to test" the in-place density using standard AASHTO or ASTM procedures shall conform to the following requirements:

Maximum Particle Dimension	6"
Minus 200 Screen Size	20% maximum
Plasticity Index (PI)	7 maximum

In addition to the above requirements, the Engineer and/or the Construction Inspector shall have the authority to determine, by visual inspection, if the material delivered to the job site contains a sufficient quantity of fine graded material to fill the voids between rocks when the material is placed and compacted.

Material that is segregated, contains too much cobble or is otherwise unsuitable for use in the backfill shall be removed from the job site or blended with other suitable material as directed or approved by the Engineer or his representative.

Pit-run and crushed asphalt are typically found to be "too rocky to test" using standard density test procedures, therefore, the Contractor shall prepare and submit a Construction Procedure Plan for approval by the Town. The plan shall describe the equipment, methods and procedures that the Contractor shall use to place and compact the material. The Town may require that the Contractor demonstrate the proposed procedures before approval is given. The Construction Procedure Plan shall include the following:

1) Source(s) of the proposed backfill material.
2) Equipment to be used for placement and compaction of the material.
3) Description of how moisture content of the material will be tested, and, if necessary, adjusted.
4) Description of methods that will be used to place the material in the trench or excavation including the maximum lift thickness to be placed and compacted.
5) Description of the method of compaction including equipment to be used.

Construction Inspection. When the embankment or backfill material is too rocky to test, the Town requires full-time inspection and observation during the placement and compaction of the material to assure compliance with the approved Construction Procedure Plan.

Moisture Content Monitoring. The pit-run material shall be sampled and tested for moisture content at the same frequency specified in Section 103.14 for compaction testing. Samples for moisture content tests shall be randomly taken from the material being placed. The moisture content of the material shall not deviate from optimum on the dry side by more than two percentage points as determined by AASHTO T 99 or T 180. Moisture content testing shall be performed by the Inspector or by an independent laboratory at the Owner's expense.

Proof Rolling. The Engineer or Construction Inspector may require proof rolling of the compacted pit-run aggregate to test for deflection. The Contractor shall furnish a rubber-tired,

self-propelled vehicle for proof rolling. If while proof rolling, any visible deflection or rutting is observed, additional compaction of the pit-run aggregate will be required.

103.17 Restoration of Grounds

The cleanup and restoration of grounds shall be a continuous process from the beginning of construction to final completion of the work. The Contractor shall keep the work site free from accumulation of debris and waste material caused by his operation.

After the pipeline is backfilled, the area shall be cleaned and restored to the original grade and condition. The cleaning and restoration shall be kept up to no greater than 500 feet behind the backfill operations unless the Construction Drawings or Contract Documents indicate otherwise. All fences, utilities, culverts, ditches, structures, grassed areas and plantings shall be replaced and restored to a condition equal to or better than that at the beginning of construction. In the case of point-location work to be performed later in the construction process, such as water line tie-ins, the restoration (but not the clean up) of the area adjacent to the point-location may be delayed until the point-location work is performed. The restoration of asphalt and concrete surfaces and structures may be performed at the completion of a segment of the project, unless otherwise specified in the Contract Documents. A segment is defined as one contiguous length of pipe installed.

103.18 Restoration of Paved Surfaces

The Contractor shall replace all paved surfaces removed or damaged by his operation. All paving, aggregate base course and concrete replacement work shall be in accordance with the Mesa County Standard Specifications for Road and Bridge Construction or CDOT Specifications or as defined in a project permit from either agency as they may be applicable. Paving and/or patching for an entire project may be performed as a single operation unless otherwise specified in the Contract Documents.

Prior to paving or patching all edges that have been broken, raveled or otherwise damaged, shall be recut to a neat line. Refer to Mesa County Standard Specifications for Road and Bridge Construction or CDOT Specifications as they may be applicable.

All curbs, gutters, sidewalks, gutter pans, driveways and other concrete street improvements within Mesa County right-of-way shall be replaced by a licensed contractor with a permit issued as required by Mesa County or CDOT as they may be applicable.

SECTION 104 – INSTALLATION OF PIPE AND APPURTENANCES

104.1 Description

All pipe, valves, hydrants, manholes and other pipeline appurtenances shall be installed and tested in accordance with these specifications and manufacturer's instructions. When installation instructions or procedures differ, the Town Representative or Town Engineer will determine which will take precedence over the others.

All newly constructed sewer pipe shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection. Water used for flushing pipelines shall not be discharged into the existing Clifton Sanitation District system or proposed lift station.

104.2 Installation of Gravity Flow Pipelines

Gravity flow pipelines covered by this specification include sanitary sewer lines. All sanitary sewer facilities shall be in compliance with design criteria of the Colorado State Department of Health.

104.2a Pipe Laying of Gravity Flow Pipelines

After the trench has been de-watered and the bedding prepared in accordance with Section 103, the pipe shall be laid to the line and grade shown on the Construction Drawings. Variance from the designed location and elevation at the ends of every pipe section shall not be greater than three inches (3") horizontally and two inches (2") vertically while still maintaining minimum positive slope of the pipe. Variance from the design slope shall be within 0.04% of the design slope. At no point, however, shall the slope be permitted to drop less than the allowed minimum positive slope of 0.40% or the design slope shown on the Construction Drawings, whichever is less. A deflection of up to 0.8 inches, creating a sag of not longer than 4 linear feet, will be allowed once in every 100 feet of pipe laid. If a sag is identified during lamping of the sewer line, the line will be televised, closed caption, in accordance with Section 105.2b to determine the severity of the deficiency.

The Contractor shall set the line and grade of each joint of pipe with a laser unless otherwise approved by the Town Representative or Town Engineer. Offset hubs shall be set by the Contractor's surveyor at intervals of 25 feet, 50 feet, 100 feet and 200 feet out of each manhole, inlet box, or starting point to verify vertical and horizontal line and grade of the gravity pipe being installed. Whenever the pipe is found to be outside the specified limits, the misaligned sections shall be removed and re-laid to the correct line and grade at the Contractor's expense.

Pipe shall be laid upgrade from the point of connection to the existing sewer or from a designated starting point. Pipe with bell and spigot joints shall be laid with the bell end upgrade.

The inside of the pipe and jointing surfaces shall be kept clean and free from mud, soil, gravel, groundwater, and other foreign material. When pipe laying is not in progress, the upgrade end of the pipe shall be kept closed with a tightly fitting cap or plug.

For storm drain applications, approved end sections are required at the exposed ends of all polyethylene and PVC pipe to protect the pipe from prolonged exposure to ultraviolet radiation and from damage due to burning.

Sewer Line Stub Outs. All sewer line stub outs longer than 10 feet shall terminate at a manhole, unless otherwise approved by the Town Representative or Town Engineer. The minimum length of a stub out shall be 18". Each stub out shall be connected to the manhole with a Kor-n-seal gasket, or approved equal, and plugged with a PVC cap that can be removed for future extension, yet still prevent groundwater infiltration. The manhole base shall be formed to provide positive flow through the manhole from the inverts of all connecting pipes, including stub outs.

Minimum bury for all sewer mains within right-of-way or easement is four (4) feet unless otherwise approved by the Town.

104.2b Installation of Sewer Service Line

Sewer service pipe within the public right-of-way shall be laid at a minimum grade of one-fourth inch (1/4") per linear foot (2%) unless otherwise approved by the Town Representative

or Town Engineer. Flatter slopes between one-eighth inch (1/8") (1%) and one-fourth inch (1/4") per foot will be allowed only when there is not enough elevation difference to achieve one-fourth inch (1/4") per foot as verified by survey. Sewer service pipe and connections to the sewer main shall be completed by an approved Contractor and be inspected by a Town Inspector prior to backfilling. The location and alignment of service lines shall be established by the Engineer.

The maximum deflection permissible at any one fitting or any combination of adjacent fittings shall not exceed 90 degrees. Ninety degree fittings shall be the long radius type.

Small Diameter Taps. Four-inch service lines shall be joined to the new sewer mains with a full body wye fitting connected above the spring line of the sewer pipe. For existing main lines the Town will provide direction as to tap method to be used.

Large Diameter Taps. All 6" or larger service taps shall be accomplished using a manhole. On 8" or smaller main lines in which projected flows will be less than 1/3 full, the 6" service line shall enter the manhole approximately 0.2' higher than the invert of the existing pipe. On larger mains, the 6" line shall be placed vertically so that flow from the main line does not back into the service line.

All Taps. On all existing main lines such as concrete, clay, or PVC, Inserta Tees, as specified in Section 102.7 shall be used in accordance with the manufacturer's recommendations. Verify that the supplied tee is intended for the diameter and type of the existing pipe. At no point shall the tee protrude more than ½ inch into the existing pipe.

For the installation of sewer service lines to properties that will not be immediately connecting or reconnecting to the sewer system, the service lines shall be stubbed out to the house side of the multi-purpose easement, utility easement or right-of-way line where no easement exists. The end of the pipe shall be plugged and marked with either a 2"x4" wood post or steel fence post buried vertically above the end of the pipe and extending 3 feet above the ground surface with the exposed portion painted green. The ends of the service lines shall be capped with watertight plugs braced to withstand test pressures. The horizontal and vertical location of each service tap shall be measured and shown on the As-Built Drawings PRIOR to backfilling. The Contractor shall mark the end of the service with a post, as required above, with a reference mark and depth to the service pipe to be shot for elevation and documented at a later date. Tap locations shall be referenced using the stationing shown on the plans or referenced to property corners unless otherwise approved by the Engineer.

Where a PVC sewer service line is connected to an existing PVC service line, the connection shall be made with an approved gasketed PVC repair coupling. Where a PVC service line is connected to an existing service line of concrete, vitrified clay pipe, orangeburg, or truss pipe, a Mission type coupling with stainless steel bands, or Town approved equal, shall be used. Mission type couplings need not be encased in concrete.

All service lines over 100 feet in length have a clean-out installed in accordance with the Uniform Plumbing Code. When the clean-outs are within the right-of-way, the clean-outs shall be enclosed in a 24" diameter concrete barrel with a standard ring and cover suitable for traffic loads as shown on the Standard Drawings.

Sub-drains and/or French drains will not be permitted to be connected to sanitary sewers.

Minimum bury for all sewer services within right-of-way or easement is two (2) feet unless otherwise approved by the Town.

104.2c Construction of Manholes

The foundation for each manhole base shall be prepared by replacing unsuitable material with sub grade stabilization material in accordance with Section 103.8 and placing granular bedding material in accordance with the Standard Drawings.

The manhole base shall be precast or cast-in-place. The lines and grades of the pipe inverts shall be staked, as shown on the Construction Drawings. The invert shall be formed and smoothly finished to match the shape and elevation of all pipes connected to the manhole. Where the sewer line is designed with a continuous grade through the manhole, the pipe shall be laid through the manhole location, the top half of the pipe cut out and the manhole base formed around the bottom half of the pipe. A pre-cast base with a pre-cast invert may be used where there is at least 0.16 feet of elevation difference across the manhole.

For concrete coated manholes, the concrete invert shall be formed or removed to a depth to allow room to apply the coating to match to pipe invert and maintain positive fall through the manhole. The cured surface of the coating shall be smooth, free of trowel marks and shall have a cross section consistent with that of the PVC pipe.

Waterstops shall be installed on all pipes going into or out of a cast-in-place base. Waterstops shall be placed on both the uphill and downhill sides of the manhole on pipes laid continuously through a manhole. For pre-cast bases the pipes shall be connected to the base with flexible rubber boots with stainless steel straps.

If cast-in-place bases are used, the first pre-cast manhole section shall be placed on the concrete base structure before the base has taken initial set, or the section shall be grouted into a suitable groove formed in the top of the manhole base. The first section shall be adjusted to the proper grade and alignment so that it is uniformly supported by the base concrete and not bearing on any of the pipes. The manhole steps shall be located one-foot left or right of the main inflow pipe.

The remaining pre-cast sections shall be placed and aligned to provide vertical sides and alignment of the ladder rungs. Plumbness shall be checked as each barrel section is added. A bitumastic or other approved sealer shall be placed between pre-cast sections so that the completed manhole is rigid and watertight. The sealer shall be placed both on the inside lip as well as the outside lip of each section.

The manhole ring and cover shall be adjusted to the final pitch and grade with mortar and pre-cast concrete grade rings. The total height of the grade rings shall not be more than twelve inches (12”). Grade rings shall be dry stacked and the cast iron ring set in a bed of mortar at the finished grade elevation. Cast iron grade rings shall not be used to adjust the elevation of the manhole lid, except when a street is being overlaid. Inverted rings and covers will not be permitted without the approval of the Town Representative or Town Engineer.

Where the manhole is in an unpaved street, alley or other area where grade has not been established, 6 to 12 inches of grade rings shall be placed between the top of cone and bottom of the ring (to allow future adjustment of the ring to grade).

Where the manhole is in an unpaved area, a concrete collar with a #4 rebar hoop shall be cast around the ring and cover. The concrete collar shall be a continuous section with minimum dimensions of 12 inches wide and minimum 12 inches thick. Concrete shall extend from the top of the cast iron ring to six (6) inches below the top of the concrete manhole cone.

Where a manhole is in a cultivated or landscaped area, a watertight manhole cover shall be used. In cultivated areas, the top of the casting shall be 18 to 24 inches below the existing ground surface.

All newly constructed manholes shall be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection. All ram-neck shall be trimmed flush with manhole wall.

104.3 Polyethylene Encasement

Prior to backfilling, all cast iron and ductile iron pipe, fittings, valves and appurtenances shall be wrapped with polyethylene encasement material. All other metal pipes and fittings, except copper service lines, shall be wrapped with polyethylene encasement material. Polyethylene film shall have a minimum thickness of 0.008 inches (8 mil). Installation of the polyethylene encasement shall be in accordance with one of the methods described in AWWA C105. If a soil survey has been performed in accordance with Appendix A of AWWA C105 and the soil is found to not be corrosive to ductile iron, the ductile iron pipe and fittings may be installed without a polyethylene encasement. When performing soil survey according to AWWA C105, only the four-pin method of measuring earth resistivity will be acceptable.

Ductile iron valves and fittings shall be fully encapsulated by the polyethylene encasement, except the valve opening nut. The ends of the polyethylene shall be taped around the full circumference of the pipe. If the polyethylene is cut or more than one piece is used to wrap the valve or fitting, the pieces shall overlap a minimum of 12 inches and the full length of the seam shall be taped.

Concrete Blocking. The size and location of concrete blocking shall be as shown on the plans or in accordance with the Standard Drawings. Thrust blocks shall be poured on firm, stable foundation material and all bearing surfaces shall be against undisturbed earth.

Concrete for thrust blocks shall be made with modified Type II Portland cement and shall reach a minimum compressive strength of 3000 psi in 28 days. Reinforcing steel and bolts used to anchor valves, fittings, etc., to thrust blocks shall meet tensile requirements of ASTM Grade 40. All anchorage steel not embedded in concrete shall be factory epoxy coated or Cor-Ten steel.

Mechanical Restraint. Valves and fittings may be restrained by mechanically connecting them to the pipe or other fittings.

104.3a Installation of Gate Valves and Valve Boxes

Each gate valve shall be installed in a vertical position and set on a concrete support block as shown on the Standard Drawings. An adjustable slip type valve box shall be set into position during backfilling operations. The upper section of the unit shall be placed in proper alignment and adjusted so that its top will be at final grade. The completed valve box shall be vertically centered over the valve operating nut. Each valve shall be checked for proper access and operation prior to paving, and after paving.

104.3b Installation of Butterfly Valves

Each butterfly valve shall be installed in a vault. Pipe or valve supports shall be provided within the vault. All support materials shall be suitable for use in wet corrosive conditions. The diameter of the vault shall be as detailed on the plans.

104.4 Relationship Between Water Lines and Sanitary Sewers

To reduce the possibility of contamination of the domestic water supply in the event of a water line break or repair, the following construction techniques shall be used when a water line and

a sanitary sewer line are installed in close proximity to each other. These requirements shall apply to main lines.

1) If the sewer line is above and within 10 feet horizontally of the water line, the sewer line shall be installed through a steel or ductile iron casing pipe or encased in reinforced concrete as shown on the Standard Drawings. The casing pipe or concrete encasement shall extend a minimum of 10 feet on either side of the water line, measured perpendicular to the water line.

2) If the sewer line is 18" or less clear distance below and within 5 feet horizontally of the water line, the sewer line shall be installed through a steel or ductile iron casing pipe or capped with concrete as shown on the Standard Drawings. The case pipe or concrete cap shall extend a minimum of 10 feet on either side of the water line, measured perpendicular to the water line.

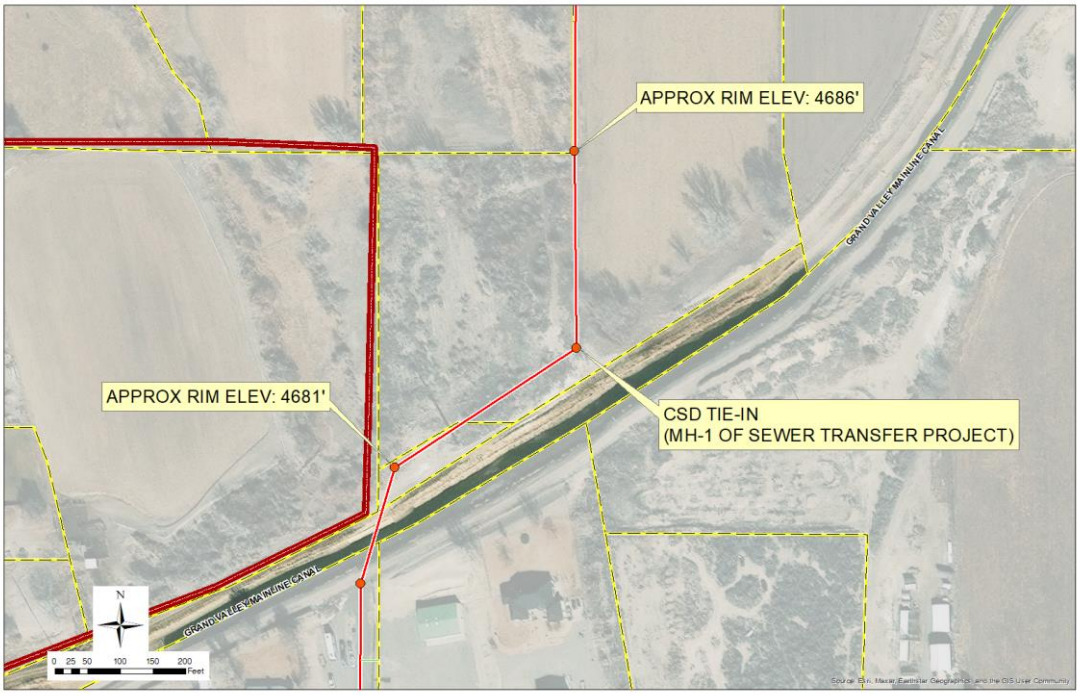
In all cases, suitable backfill or other structural protection shall be provided to preclude the settling or failure of both pipes.

Crossings of sewer and water lines shall not be at an angle less than 45 degrees nor shall a sewer line and water line be installed within 10 feet of each other unless approved by the Town Representative or Town Engineer.

104.5 Bypass Pumping

The design and construction of all necessary temporary bypass pumping will be the contractor's responsibility. Contractor shall provide a bypass pumping plan for each set up and is responsible for establishing the pump capacity necessary for the bypass system. Redundancy of pumping capacity to safely bypass flow in the existing lines associated with this project and ensuring lines above the work zone are not surcharged will be the Contractor's responsibility. Damages caused by failure of bypassing will be Contractor's responsibility. Bypass manhole exhibits at the Palisade and Clifton tie-ins are provided below.





104.6 Traffic Control

A Traffic Control Plan shall be prepared by the Contractor and reviewed by the Town two days prior to the pre-construction meeting. The Contractor shall provide and maintain all traffic control in accordance with this Traffic Control Plan and the Manual on Uniform Traffic Control Devices. The Contractor shall provide all traffic control measures and responsible oversight in accordance with Mesa County and CDOT permits.

SECTION 105 – PIPELINE TESTING

105.1 Testing

All pipelines shall be tested before final acceptance. All testing shall be performed by the Contractor under direct control and observation of the Town Representative, Engineer or an approved independent laboratory. The Contractor shall furnish all labor, equipment, tools, water and other incidental items required to conduct the tests. If a pipeline fails to meet the test requirements, the leak or other deficiency shall be located and repaired at the Contractor's expense. After the repairs or corrections have been made, the pipeline shall be retested. Repairs and retesting shall continue until the test requirements have been met.

105.2 Testing Sanitary Sewers

All sanitary sewer lines shall be tested for leakage and alignment before acceptance.

105.2a Leakage Tests

A leakage test shall be performed on all newly constructed sanitary sewers. The Contractor will determine which type of test will be made and furnish all labor, tools and equipment necessary to conduct the test. The allowable types of tests include exfiltration of water, exfiltration of air and infiltration of water.

Exfiltration of Water Test. The length of pipeline to be tested shall be limited so that the pressure on the lower end of the test section does not exceed ten feet (10') of water column. The test section shall be sealed off from the remaining pipeline with watertight plugs inserted in the pipes. The Contractor shall fill the pipe to the test level with potable water at least 24 hours prior to conducting the test. The test level shall be at least two feet (2') above the top of the pipe in the upper manhole or two feet (2') above the groundwater table, whichever is higher.

Throughout the test period of at least one (1) hour, the water level shall be maintained at the test level and all water added shall be accurately measured. The exfiltration rate shall not exceed 0.15 gallon per inch of inside pipe diameter per hour per 100 feet of pipe length.

Exfiltration of Air Test. Air testing shall be in accordance with ASTM C828. The ends of the test section shall be sealed at the upper and lower manholes with pneumatic plugs. One of the plugs provided shall have two taps. One tap will be used for introducing air into the pipeline through suitable valves and fittings to accept a pressure gauge to monitor the internal pressure of the sewer pipe.

The pressure gauge shall meet the following minimum specifications:

Size	4-1/2-inch diameter
Pressure Range	0 – 15 psi
Figure Intervals	1-psi increments
Smallest Intervals	0.1 psi
Pressure Tube	Bourdon tube or diaphragm

Connect the pressure gauge and air control equipment to the proper fittings and slowly apply air pressure. Pressurize the pipe line to 4.0 psig and throttle the air supply to maintain the pressure between 4.0 and 3.5 psig for at least two (2) minutes in order to allow equilibrium between air temperature and pipe walls. During this time check all plugs for leakage. If any plugs are found to leak, bleed off the air, tighten the plugs and repressurize the pipeline. After the temperature has stabilized, allow the pressure to decrease to 3.5 psig. At 3.5 psig begin timing to determine the time required for pressure to drop to 2.5 psig. The time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig shall be greater than the minimum test time shown in the following table.

Nominal Pipe Size (inches)	Time (min/100 ft)	Nominal Pipe Size (inches)	Time (min/100 ft)
4	0.3	*columns continued*	
6	0.7	24	3.6
8	1.2	27	4.2
10	1.5	30	4.8
12	1.8	33	5.4
15	2.1	36	6.0
18	2.4	39	6.6
21	3.0	42	7.3

In areas where the groundwater level is above the pipe, the hydrostatic pressure of the groundwater above the pipeline shall be determined and added to all test pressures (1 ft of water = 0.43 psi). Air testing shall not be done if the groundwater level is greater than 10 feet above the sewer line.

Infiltration of Water Test. If the sewer line is in an area where the water table is two feet (2') or more above the pipeline, an infiltration test may be used. Infiltration tests shall be completed prior to placing new sewer lines in service. The infiltration of groundwater will be measured with special made weirs, which will be inserted in the pipeline at manholes where flow is present. The infiltration rate shall not exceed 0.15 gallon per inch of inside pipe diameter per hour per 100 feet of pipe length.

Regardless of test results, if visible infiltration is observed in a manhole or pipe the infiltration shall be fully eliminated prior to final acceptance of the project. The Contractor shall submit the mitigation method to the Town for approval prior to completing the work.

105.2b Alignment Testing

All sanitary sewer lines shall be observed for correct alignment by lamping. If the line does not pass the lamping test or if something other than crushed rock was used for pipe bedding, deflection testing shall be performed on flexible pipe or appropriate repairs shall be made on rigid pipe.

Lamping Test. Lamping will be performed on all sanitary sewer pipe by the Town Representative or Engineer. All lines will be flushed at least 24 hours and no more than 48 hours prior to lamping. In order to pass the lamping test, no deformations or defects shall be observed in the pipe, the full vertical height of the pipe shall be observed and three fourths (3/4) of the pipe circle shall be observed horizontally.

For systems where a sewer line is allowed by the Town Representative or Engineer to be stubbed out for a future extension without a manhole on the end, the trench shall be backfilled up to the end of the line but the end of the pipe shall remain accessible. The line shall be lamped from the open end of the pipe to the next downstream manhole.

Deflection Testing for Flexible Pipe. The maximum allowable deflection of flexible pipe shall be seven and one half percent (7.5%) of the Base Inside Diameter. The following values from ASTM D3034 shall apply for SDR 35 PVC sewer pipe:

Nominal Pipe Size (inches)	Base Inside Diameter (inches)	Mandrel Diameter (inches)
6	5.74	5.31
8	7.665	7.09
10	9.563	8.84
12	11.361	10.51
15	13.898	12.86

The deflection test will be performed by pulling a mandrel through the pipe from manhole to manhole.

Closed Caption Television (CCTV). The Contractor shall perform CCTV of sanitary sewer and deliver a copy to the Town. This must be performed between 24 and 48 hours after flushing and will be used for acceptance review of the pipeline and to determine if repairs are needed.

105.2c Forcemain Testing

Forcemain shall be tested for pressure and leakage in accordance with AWWA Standard C-603, Section 4 and 5. The Contractor shall furnish all labor, equipment, tools, water, and other incidental items required to conduct the tests.

SECTION 106 – FINAL INSPECTION AND ACCEPTANCE

106.1 Final Inspection and Acceptance

The acceptance of all pipelines by the Town will be based on the following:

1. Red-lined as-builts of sewer facilities including inverts on services are required PRIOR to paving.

2. Passing a final inspection of the Work by the Town Representative or his representative.

3. Submittal of satisfactory results of tests (such as pipeline pressure test, leakage tests, etc.) required to be performed by the Contractor.

4. Contractor is responsible to coordinate with the Town Engineer as needed for as-built drawings which shall also include the following information. For sewers: horizontal and vertical information on all pipe, manholes, catch basins and service stub outs including grades. For water lines, both potable and irrigation: all horizontal and vertical information shall be neatly printed on a copy of the plan set.

SECTION 107 – INCIDENTAL CONSTRUCTION

The following list of materials and items of work may be required to complete the Work but may or may not be shown on the plans or described in the Contract Documents. Unless otherwise specified or provided for in the Bid Schedule, these items will be considered incidental to the Work and will not be measured or paid for separately. All costs for the following incidental items shall be included in the contract prices for the various pay items listed in the Bid Schedule.

1. The furnishing and maintenance of barricades, warning signs and other traffic control devices.
2. All surface removals including removal of fences, mail boxes, plantings and structures.
3. The location and protection of existing utilities.
4. All excavation except rock excavation (see Section 103.11 for payment for rock excavation).
5. The support bracing and sheeting of trenches.
6. The dewatering of trenches.
7. The furnishing and placement of all pipe bedding and haunching material.
8. The furnishing and placement of backfill material where not approved by Engineer for use.
9. The furnishing and placement of granular stabilization material where not approved by Engineer for use.
10. The furnishing and placement of all pipeline cutoff walls.
11. The clean-up and restoration of grounds for items not listed in 400 sheets of Drawings.
12. The removal and disposal of all waste materials including excess excavated material, trash and debris resulting from the Work.
13. The furnishing and installation of tracing wire.
14. The furnishing and installation of polyethylene encasement material for all metal pipe, valves, fittings and other metal surfaces.
15. The furnishing and installation of restraints, whether mechanical or concrete support and thrust blocking, required on pressure pipelines.
16. All pressure and leakage testing.
17. The connection of new pipeline to existing facilities.
18. The separation, removal and disposal of muck, large rock, organic matter or other materials from project excavations, which in the opinion of the Engineer are unsuitable for use in the backfill. No separate or additional payment will be made for hauling and disposing of unsuitable materials.

19. Concrete encasement of sewer line connections and sewer service line connections.
20. Bolted Watertight Covers for manholes.
21. Unless otherwise identified in the plans, the removal and replacement of underground utilities as required to trench proposed sewer line. Where water line service is damaged by construction, Contractor to remove and replace service between meter and corp stop.
22. The placement of manhole markers.
23. All cold weather protection for equipment and people.

SECTION 108 – GENERAL NOTES

1. Contractor shall have one signed copy of plans and a copy of the Specifications at the job site at all times.
2. All sewer mains shall be PVC SDR 35 (ASTM D3034) unless otherwise noted.
3. All sewer mains shall be laid to grade utilizing a pipe laser.
4. All service line connections to new mains shall be accomplished with full body wyes or tees unless specified by Town Representative.
5. Service line connections to existing mains shall be accomplished by using tapping saddles or Inserta Tee pending type of main line pipe and as directed by the Town or its Representative.
6. No four-inch services shall be connected directly into manholes without prior approval. All six-inch services shall be accomplished inside a manhole.
7. The Contractor is responsible for all required sewer line testing to be completed in the presence of the Town Representative. Pressure testing will be performed after installation of dry utilities, after all compaction of street subgrade and prior to street paving. Final lamping will also be accomplished after paving is completed. These tests shall be the minimum basis of acceptance of the sewer line extension.
8. The Contractor shall obtain, or have transferred to him, Mesa County road cut permits, or CDOT Utility permits, for all work within existing right-of-way prior to construction.
9. Sewer Service stub outs shall be capped and plugged. Stub outs shall be marked with a 2x4 inch post or steel post painted green and extending 3 feet above grade. As-built surveying for vertical and horizontal grade of stub out required prior to backfill.
10. Red line as-builts shall be submitted to the Town at least 72 hours prior to paving for review.
11. All service line connections to new mains shall be accomplished with full body wyes or tees.
12. No four-inch services shall be connected directly into manholes without prior approval. All six-inch services shall be accomplished inside of a manhole.
13. The Contractor shall notify the Town Inspector 48 hours prior to commencement of construction.
14. The Contractor is responsible for all required sewer line testing to be completed in the presence of the Town Inspector. Pressure testing will be performed after installation of dry utilities, after all compaction of street sub grade and prior to street paving. Final lamping will also be accomplished after paving is completed.
15. The Contractor shall obtain Mesa County Road Cutting permits for all work within existing County rights-of-way prior to construction. A copy of this permit is to be submitted to the Town prior to construction.
16. All work shall be in accordance with approved plans and specifications.

Manhole Notes:

1. Concrete for pre-cast manholes shall be Colorado Department of Transportation Class “B” (Section 601.02).
2. All cement used in mortar, concrete bases, grade rings, riser sections, cones and flat tops, for sanitary sewer, shall be type V or modified type II Portland cement with less than 5% Tricalcium Aluminate.
3. Manhole riser sections, cones, flat tops and grade rings shall be precast reinforced concrete conforming to ASTM C478 or AASHTO M 199.
4. Backfill around manholes and other structures shall be placed in 12-inch maximum lifts and compacted to 95% AASHTO T 99, or T 180 as identified in the Contract or by the Engineer.

5. All work shall be in accordance with approved plans and Town specifications.
6. Manhole cone and flat top sections shall be positioned such that the manhole ring and cover is centered on the upstream flow line. If the cone is furnished with steps, the manhole ring and cover will be shifted so that the steps are installed at a 12” offset from the inlet pipe.
7. If the manhole sections are furnished with steps they shall be installed at a 12” offset from the inlet pipe to facilitate cleaning and TV equipment.
8. Manhole ring and cover shall be set to finish grade using rapid road repair (or approved equal) grout to adjust rim elevation. Grout shall not exceed 0.10 feet thickness. Grout shall be placed between top of concrete grade ring and ring and cover. Steel paving rings are not allowed for grade adjustment unless otherwise approved by the Town.

END SPECIFICATIONS

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TECHNICAL SECTION 3: SITEWORK
(LIFT STATION)

FOR

Town of Palisade, Colorado
Sewer Transfer Line

December 2025

Prepared by: J-U-B Engineers, Inc.
81-23-029

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TOWN OF PALISADE

PALISADE SEWER TRANSFER

TECHNICAL SECTION 3:
LIFT STATION TECHNICAL SPECIFICATIONS
(DIVISIONS 01 TO 46)

BID SET

December 2025

Funded By:
Town of Palisade
USDA Rural Development

Prepared By:
J-U-B Engineers, Inc.
305 Main Street
Palisade, CO 81526
Project No. 81-23-029

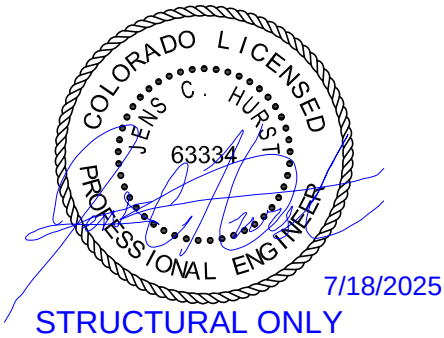
For:
Town of Palisade
175 E. 3rd Street, P.O. Box 128
Palisade, CO 81526
970-464-5602

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TOWN OF PALISADE

PALISADE SEWER TRANSFER
TECHNICAL SPECIFICATIONS

RESPONSIBLE PARTIES FOR TECHNICAL SPECIFICATIONS

 Divisions 22 & 23	 Division 40
 Division 26	 STRUCTURAL ONLY

ALL CONSTRUCTION AND MATERIAL SHALL BE IN ACCORDANCE WITH THESE CONTRACT DOCUMENTS, INCLUDING ALL APPLICABLE SECTIONS OF THE CLIFTON SANITATION DISTRICT CONSTRUCTION STANDARDS AVAILABLE AT WWW.CLIFTONSANITATION.COM. ANY CONSTRUCTION AND MATERIAL NOT EXPLICITLY IDENTIFIED IN THE CONTRACT DOCUMENTS OR THE CLIFTON SANITATION DISTRICT CONSTRUCTION STANDARDS SHALL BE IN ACCORDANCE WITH THE MOST RECENT EDITION PUBLISHED BY THE AMERICAN PUBLIC WORKS ASSOCIATION (APWA).

SECTION	RESPONSIBLE ENGINEER OR ARCHITECT	TITLE
DIVISION 01 – GENERAL REQUIREMENTS		
01 60 10	J-U-B	Design Requirements for Non-Structural Components and Non-Building Structures
01 65 00	J-U-B	Commissioning of Systems
01 70 00	J-U-B	Closeout Requirements
01 73 00	J-U-B	Installation, Operation, and Maintenance Manuals
DIVISION 03 – CONCRETE		
03 01 00	J-U-B	Maintenance of Concrete
03 10 00	J-U-B	Concrete Forms and Accessories
03 20 00	J-U-B	Concrete Reinforcement
03 30 00	J-U-B	Cast-In-Place Concrete
03 35 00	J-U-B	Concrete Finishing
03 39 00	J-U-B	Concrete Curing
03 41 00	J-U-B	Testing Concrete Structures for Watertightness
03 60 00	J-U-B	Grouting
DIVISION 04 – MASONRY		
04 01 00	J-U-B	Maintenance of Masonry
04 10 00	J-U-B	Mortar and Grout
04 30 00	J-U-B	Reinforced Unit Masonry
DIVISION 05 – METALS		
05 04 10	J-U-B	Hot-Dip Galvanizing
05 12 00	J-U-B	Structural Steel
05 50 00	J-U-B	Metal Fabrications
05 51 00	J-U-B	Metal Stairs
05 52 50	J-U-B	Aluminum Handrails and Railings
DIVISION 06 – WOOD, PLASTICS, & COMPOSITES		
06 10 00	J-U-B	Rough Carpentry
06 19 30	J-U-B	Plate Connected Wood Trusses
06 30 00	J-U-B	Wood Preservative Treatment
DIVISION 07 – THERMAL & MOISTURE PROTECTION		
07 11 13	J-U-B	Bituminous Damp Proofing
07 19 00	J-U-B	Water Repellents (Masonry)
07 21 00	J-U-B	Building Insulation
07 41 10	J-U-B	Metal Roof Panels
07 62 10	J-U-B	Sheet Metal Flashing and Trim
07 92 00	J-U-B	Joint Sealants – Architectural

SECTION	RESPONSIBLE ENGINEER OR ARCHITECT	TITLE
07 92 13	J-U-B	Sealants and Caulking
DIVISION 08 – OPENINGS		
08 71 00	J-U-B	Door Hardware
DIVISION 09 – FINISHES		
09 25 00	J-U-B	Gypsum Board
09 90 00	J-U-B	High Performance Coatings
09 91 00	J-U-B	Architectural Painting
DIVISION 11 – EQUIPMENT		
11 53 23	J-U-B	Refrigerated Composite Sampler
DIVISION 14 – CONVEYING SYSTEMS		
14 30 00	J-U-B	Monorail
DIVISION 22 – PLUMBING		
22 05 13	BHE	Common Motor Requirements for Plumbing Equipment
22 05 16	BHE	Expansion Fittings and Loops for Plumbing Piping
22 05 17	BHE	Sleeves and Sleeve Seals for Plumbing Piping
22 05 19	BHE	Meters and Gauges for Plumbing Piping
22 05 23	BHE	General Duty Valves for Plumbing Piping
22 05 29	BHE	Hangers and Supports for Plumbing Piping and Equipment
22 05 48	BHE	Vibration and Seismic Controls for Plumbing Piping and Equipment
22 05 53	BHE	Identification for Plumbing Piping and Equipment
22 07 16	BHE	Plumbing Equipment Insulation
22 07 19	BHE	Plumbing Piping Insulation
22 10 05	BHE	Plumbing Piping
22 10 06	BHE	Plumbing Piping Specialties
22 30 00	BHE	Plumbing Equipment
22 40 00	BHE	Plumbing Fixtures
DIVISION 23 – HEATING, VENTILATION, & AIR CONDITIONING		
23 05 13	BHE	Common Motor Requirements for HVAC Equipment
23 05 29	BHE	Hangers and Supports for HVAC Piping and Equipment
23 05 48	BHE	Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 93	BHE	Testing, Adjusting, and Balancing for HVAC
23 07 13	BHE	Duct Insulation
23 07 16	BHE	HVAC Equipment Insulation
23 31 00	BHE	HVAC Ducts and Casings
23 33 00	BHE	Air Duct Accessories
23 34 13	BHE	Axial HVAC Fans

SECTION	RESPONSIBLE ENGINEER OR ARCHITECT	TITLE
23 34 16	BHE	Centrifugal HVAC Fans
23 34 23	BHE	HVAC Power Ventilators
23 37 00	BHE	Air Outlets and Inlets
23 40 00	BHE	HVAC Air Cleaning Devices
23 82 00	BHE	Convection Heating and Cooling Units
DIVISION 26 – ELECTRICAL		
26 05 05	BHE	Selective Demolition for Electrical
26 05 19	BHE	Low-Voltage Electrical Power Conductors and Cables
26 05 26	BHE	Grounding and Bonding for Electrical Systems
26 05 29	BHE	Hangers and Supports for Electrical Systems
26 05 33.13	BHE	Conduit for Electrical Systems
26 05 33.16	BHE	Boxes for Electrical Systems
26 05 53	BHE	Surface Raceways for Electrical Systems
26 05 73	BHE	Power System Studies
26 05 83	BHE	Wiring Connections
26 09 23	BHE	Lighting Control Devices
26 21 00	BHE	Low-Voltage Electrical Service Entrance
26 22 00	BHE	Low-Voltage Transformers
26 23 00	BHE	Low-Voltage Switchgear
26 24 13	BHE	Switchboards
26 24 16	BHE	Panelboards
26 24 19	BHE	Motor Control Centers
26 27 13	BHE	Electricity Metering
26 27 26	BHE	Wiring Devices
26 27 33	BHE	Power Distribution Units
26 28 13	BHE	Fuses
26 28 16.13	BHE	Enclosed Circuit Breakers
26 28 16.16	BHE	Enclosed Switches
26 32 13	BHE	Engine Generators
26 33 53	BHE	Static Uninterruptible Power Supply
26 36 00	BHE	Transfer Switches
26 36 33	BHE	Connection Cabinets for Portable Generator and Load Banks
26 43 00	BHE	Surge Protective Devices
26 51 00	BHE	Interior Lighting
26 56 00	BHE	Exterior Lighting
DIVISION 31 – EARTHWORK		

SECTION	RESPONSIBLE ENGINEER OR ARCHITECT	TITLE
31 05 16	J-U-B	Aggregate Materials
31 05 19	J-U-B	Geotextiles
31 10 00	J-U-B	Site Clearing
31 11 20	J-U-B	Soil Materials
31 22 13	J-U-B	Rough Grading
31 23 19	J-U-B	Dewatering
31 23 23	J-U-B	Backfilling for Structures
DIVISION 33 – UTILITIES		
33 05 60	J-U-B	Precast Concrete Utility Structures
DIVISION 40 – PROCESS INTERCONNECTIONS		
40 06 10	J-U-B	Pipe and Fittings
40 90 00	Browns Hill	Instrumentation and Controls
40 95 00	Browns Hill	Programmable Logic Controllers
DIVISION 43 – MATERIAL HANDLING EQUIPMENT		
43 05 10	J-U-B	Equipment General Provisions
43 25 04	J-U-B	Dry-Pit Submersible Wastewater Pumps
43 30 00	J-U-B	Hydraulic Process Valves

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SECTION 01 60 10
DESIGN REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS AND NON-BUILDING STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes: Minimum structural requirements for the design, anchorage, and bracing of Non-Structural Components such as architectural, process mechanical, mechanical/HVAC, electrical components, equipment, or systems, and Non-Building Structures such as tanks.

B. The requirements of this section apply to design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or Non-Building Structures .

C. This section applies to Non-Building Structures and Non-Structural Components that are permanently attached to structures as defined below and in American Society of Civil Engineers (ASCE) 7.

D. Design shall conform to criteria and design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing when specifically detailed on the Drawings, nor where the size of attachments, anchorage, or bracing is specifically defined in individual equipment technical specification sections.

E. The following Non-Structural Components are exempt from seismic design loading requirements of this section.

1. Mechanical and electrical components in Seismic Design Categories C, D, E, or F where all of the following apply:

    a. The component importance factor, Ip, is equal to 1.0;

    b. The component is positively attached to the structure;

    c. Flexible connections are provided between the component and associated ductwork, piping, and conduit;

    d. And either:

        i. the component weighs 400 pounds or less and has a center of mass located four feet or less above the adjacent floor level; or

        ii. the component weighs 20 pounds or less, or in the case of a distributed systems, five pounds per foot or less.

1.2 REFERENCES

A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
Aluminum Design Manual	Aluminum Association, Aluminum Design Manual with Specifications and Guidelines for Aluminum Structures
AAMA	American Architectural Manufacturer's Association
ACI 318	Building Code Requirements for Structural Concrete
AISC 341	Seismic Provisions for Structural Steel Buildings
ACI 360	Specification for Structural Steel Buildings
ASCE 7	Minimum Design Loads for Buildings and Other Structures
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel
AWS D1.8	Structural Welding Code – Seismic Supplement
IBC	International Building Code with local amendments
NFPA-13	Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems

1.3 DEFINITIONS

A. Structure: The structural elements of a building or tank that resist gravity, seismic, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, stairs, and foundations.

B. Non-Structural Components: Non-structural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist effects of wind, snow, impact, temperature and seismic loads. Non-structural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.

C. Non-Building Structures: Self-supporting structures that carry gravity loads and that may also be required to resist the effects of wind, snow, impact, temperature and seismic loads. Non-building structures include, but are not limited to, pipe racks, storage racks, stacks, vessels and structural towers that support pipes, pre-fabricated tanks and vessels.

1.4 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.

2. For structural elements of Non-Structural Components and Non-Building Structures required to be designed per the Contract Documents, provide drawings and design calculations stamped by a licensed professional engineer qualified to perform structural engineering in the state the project resides.

3. List of Non-Structural Components and Non-Building Structures requiring seismic design and anchorage.

4. Shop drawings showing details of complete seismic bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.

5. Shop drawings showing plans, elevations, sections and details of equipment support structures and Non-Building Structures, including anchor bolts, structural members, platforms, ladders, and related attachments.

6. Identify interface points with supporting structures or foundations, as well as size, location, and grip of required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Equipment manufacturers shall design anchor bolts, including embedment into concrete, and submit stamped calculations.

7. Calculations for supports, bracing, and attachments shall clearly indicate design criteria applied. Coordinate concrete embedment calculations with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level) equipment loads at each support point, broken down by type of loading (dead, live, wind, seismic, etc.). Indicate impact factors applied to these loads in design calculations.

1.5 QUALITY ASSURANCE

A. Quality Control By Owner:

1. Special Inspection of Non-Structural Components and Non-Building Structures , and their anchorages shall be performed by the Special Inspector under contract with the Owner and in conformance with International Building Code (IBC) Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements. Where sampling and testing required conforms to Special Inspection standards, such sampling and testing need not be duplicated. Reference Section 01 40 00 Quality Assurance and Quality Control.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide materials in conformance with information shown on the Drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

2.2 2.2 DESIGN CRITERIA

A. Design Codes

Design	Code
Buildings/Structures:	International Building Code 2018 and ASCE 7-16
Reinforced concrete:	Structures, ACI 318-14
Structural steel:	AISC 360-16 and AISC 341-16
Aluminum:	Aluminum Design Manual, Latest Edition
Welding:	AWS Welding Codes, Latest Edition
Occupational health and safety requirements:	OSHA

Note: When conflicting requirements occur, the most stringent requirements will govern the design.

B. Design Loads

1. Design Non-Structural Components and Non-Building Structures for the following minimum loads:

2. Dead Loads:

   a. Add an additional allowance for piping and conduit when supported and hung from the underside of equipment and platforms.

   b. Typical allowance for piping and conduit: 15 psf

3. Seismic Loads:

Code:	IBC 2018 & ASCE 7-16
Risk Category:	III (Wastewater Treatment Facilities are Risk Category III)
0.2 Sec. Mapped Spectral Response, S_S:	0.388 g
1.0 Sec. Mapped Spectral Response, S_1:	0.140 g
Site Class:	C
0.2 Sec. Design Spectral Response, S_{DS}:	0.336 g
1.0 Sec. Design Spectral Response, S_{D1}:	0.140 g
Importance Factor (I_e):	1.25
Component Importance Factor (I_p):	1.0, except I_p=1.5 for components identified in Section 13.1.3 of ASCE 7
Seismic Design Category	C

Notes:

1. *Calculate seismic loads on the basis of governing building code. Include equipment operating loads in structure dead load.*
2. *Check individual members for seismic and full member live load acting simultaneously, except that flooded equipment loads (infrequent occurrence) need not be combined with seismic loads. Combine equipment operating loads with seismic loads.*

4. Impact Loads:

   a. Consider impact loads in design of support systems.

   b. Use the following impact load factors unless recommendations of the equipment manufacturer will cause a more severe load case:

Rotating machinery:	20% of moving load
Reciprocating machinery:	50% of moving load

C. Load Combinations

1. Design Non-Structural Components and Non-Building Structures to withstand load combinations as specified in the governing building code. Where the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, ignore the load when evaluating that member.

D. Deflection

1. Maximum total load deflection for equipment support: L/450.

PART 3 EXECUTION

3.1 GENERAL

A. Make attachments and braces in such a manner that component force is transferred to the lateral force-resisting system of the structure. Base attachment requirements and size and number of braces per calculations submitted by Contractor.

B. Anchorage of equipment is specified to be made by cast-in anchor bolts in concrete elements unless specifically noted otherwise on the Drawings or other specification sections. Contractor is responsible for remedial work or strengthening (of concrete elements because of superimposed seismic loading) if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to Owner.

C. Submit details of and calculations for anchorages prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. Contractor is responsible for revisions to anchorages and/or strengthening of structural support so that there is no overstress condition, at no additional cost to Owner.

END OF SECTION

SECTION 01 65 00
COMMISSIONING OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section includes overall coordination, scheduling, submittals and checklists for equipment and system Start-up and Testing, Owner Training, Acceptance Testing, and Commissioning.

B. The order of events shall be as follows:

1. Initial starting and testing of equipment
2. Owner Training
3. Owner Programming Period (and support through Acceptance Testing)
4. Acceptance Testing
    a. Initial Acceptance Testing: Closed-loop testing of individual unit processes
    b. Final Acceptance Testing: Full-scale testing of interconnected unit processes
5. Commissioning

1.2 RELATED SECTIONS

A. Section 01 70 00 – Closeout Requirements

B. Section 01 73 00 – Installation, Operation, and Maintenance Manuals

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Throughout the activities discussed in this section, Contractor, and Contractor's subcontractors (as deemed appropriate by Owner and Engineer) shall be present for

repair, correction of incomplete work, alteration, or unscheduled/unforeseen adjustments to any equipment and associated systems.

B. "Equipment" consists of individual items (e.g. a pump, blower, etc.), which must function properly with interconnected and ancillary equipment and components to form a "system". "Process Areas" consist of one or more interconnected systems.

C. Contractor shall provide all labor, power, fuel, supervision, utilities, chemicals, maintenance, equipment, vehicles, water, or any other item necessary to proceed with the steps discussed in this section and other applicable portions of the Contract Documents. This includes all temporary systems, plugs, piping, and equipment required for testing individual systems in closed loops as noted herein, or as otherwise deemed necessary by the Engineer.

D. If Contractor must reschedule any activities covered in this specification once a date has been agreed upon by all parties, Contractor shall provide a minimum of one working day's notice of cancellation prior to the agreed-upon date. The activity shall then be rescheduled based on Owner's and Engineer's availability.

3.2 INITIAL STARTING AND TESTING

A. Establish a schedule for initial starting and testing of all equipment / systems in the project. The schedule shall be included in Contractor's weekly schedule updates (reference Section 01 32 17).

B. To minimize overwhelming the Owner's staff, the Contractor shall undertake no more than one major process component (e.g. a membrane system) or two equipment items or systems (e.g. a pump, blower, or similar) per week.

C. Prepare and submit a separate detailed schedule for activities, including dates for activities, personnel involved, contact information for vendors, and other pertinent information.

D. Contractor shall conduct a meeting at least 10 working days prior to initial starting and testing of each item. Required attendance includes the following: Contractor, critical subcontractors (e.g. electrical, control system integrators), equipment vendors (remote attendance is permissible), Engineer, Owner, and others as applicable.

E. Prior to energizing the equipment or system:

1. Verify that each piece of equipment in a system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions that may cause damage.

2. Verify wiring and support components for equipment are complete and have been previously tested.

3. Verify all instrumentation and controls are complete in the system and have undergone testing in accordance with Division 26 requirements, including performing loop checks on all installed wiring. No further testing, programming, or commissioning activities can be completed until all loop checks have been completed.

4. Manufacturer shall provide an authorized representative to be present at site to inspect, check, and approve equipment / system installation prior to initial starting and testing, and to supervise placing equipment or system in operation.

F. Contractor shall confirm that additional tests and inspections as required by the manufacturer, technical specifications, and Pre-Procured Equipment Contract Documents have been completed.

G. Verify that tests, meter readings, and specified electrical characteristics agree with those required by Contract Documents and the equipment or system manufacturer.

H. Execute initial starting and testing under supervision of responsible manufacturer's representative and in accordance with manufacturers' instructions, recommendations, and requirements.

1. Minimum time on-site and number of trips to site by manufacturer's representative are listed in the respective technical specifications.

2. If not listed in the technical specifications, provide at least one 8-hour day for each equipment item.

I. Equipment / systems shall be capable of full-time operation with all associated controls, instruments, sensors, etc. completely functional (less Owner's Programming). "Bump Tests" (i.e. operating a piece of equipment for several seconds to confirm proper rotation) do not constitute starting and testing of equipment / systems. Contractor shall provide temporary pump(s), piping, and other items necessary to replicate design flows for the purpose of providing flow to system facilities for testing. Contractor is required to provide all equipment, fuel, controls, and necessary piping for suction and discharge from the pump(s) as necessary for start-up and testing purposes.

J. Notice of Completed Installation

1. Once an equipment / system has undergone Initial Starting and Testing, Contractor shall submit a certified report to Engineer (using the form inserted at the end of this specification and supplemented with manufacturer's checklists and forms) that the requirements are complete. Certificate shall be signed by Contractor and Manufacturer/Supplier. Contractor shall include a letter to Engineer titled, "Request for Notice of Completed Installation of Equipment/System *[Item]*".

2. Engineer shall review the Contractor's request, and if all obligations have been fulfilled to the satisfaction of the Engineer, the Engineer shall issue a letter to the Contractor and Owner titled: "Notice of Completed Installation of Equipment/System *[Item]*".

3. Upon issuance of "Notice of Completed Installation of Equipment/System *[Item]*" by Engineer, Contractor may proceed with Owner Training for that system/piece of equipment.

4. Once all equipment items and systems in a Process Area have undergone Initial Starting and Testing, Contractor shall issue a letter to Engineer titled, "Request for Notice of Completed Installation of Process Area *[Item]*".

5. Engineer shall review the Contractor's request, and if all obligations have been fulfilled to the satisfaction of the Engineer, the Engineer shall issue a letter to the Contractor and Owner titled: "Notice of Completed Installation of Process Area *[Item]*".

3.3 OWNER TRAINING

A. Owner Training shall not commence until "Initial Starting and Testing of Equipment/Systems" is complete and the equipment or system is able to operate satisfactorily with all associated controls, instruments, sensors, etc.

B. Contractor shall coordinate the training day and time with the Owner for an occasion when Owner's operating personnel are available. Notify Owner and Engineer a minimum of ten working days prior to intended start date of training. Training shall only occur on Tuesdays, Wednesdays, or Thursdays, unless previously approved by the Owner.

C. To minimize overwhelming the Owner's staff, the Contractor shall undertake no more than one major process component (e.g. a membrane system) or two equipment items or systems (e.g. a pump, blower, or similar) per week.

D. Manufacturer's Representative, in conjunction with Contractor, shall conduct Operator/Owner Training. Training duration shall be as listed below. Training may be completed during the same trip to site as the Initial Starting and Testing of System, if adequate time is available.

1. Minimum training time by manufacturer's representative is listed in the respective technical specifications.

2. If not listed in the technical specifications, provide at least one 8-hour day for each system.

E. Utilize operation and maintenance manuals as the basis for instruction. A complete draft copy of the Preliminary Operation and Maintenance (O&M) Manuals (see Section

01 73 00) shall be available for each of the Owner's operating personnel who attend the training. Contractor shall provide a printed copy of the Preliminary O&M for each operator who attends the training at no additional cost. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance. Owner Training shall include the use of slides, videos, literature, diagrams, and/or oral presentations as necessary to present comprehensive, detailed instruction of operation and maintenance requirements of the equipment.

F. Training shall be divided into two parts: Classroom and Field Training.

1. Classroom training shall include a slide presentation and shall utilize the Preliminary operation and maintenance manual as the basis of instruction. Contractor shall provide a printed hard copy of the slide presentation to the Owner, as well as a digital copy of the presentation on a USB.

2. Upon satisfactory completion of the classroom training, continue training with a field training session utilizing the installed equipment. Equipment shall be run in all available control modes and sequences of operation as part of the Training.

G. The Owner/Engineer may record the training sessions. The recording produced shall be the sole property of the Owner and Engineer.

H. Upon completion of “Operator/Owner Training” for each equipment item or system, submit a certified report to the Engineer (using the form inserted at the end of this specification and supplemented with manufacturer’s checklists and forms) that the requirements are complete and that system is ready for the start of the “Owner’s Programming Period.”

3.4 OWNER’S PROGRAMMING PERIOD

A. Owner shall contract separately for SCADA programming for the facility, excluding vendor-provided control packages included with equipment.

B. Duration:

1. Owner’s Programming Period shall not commence until Initial Starting and Testing of each Process Area is complete. Owner Programming Periods shall not overlap.

2. Owner reserves the right to begin portions of the programming upon Notice of Completed Installation of an individual Process Area; however, such work shall not reduce the calendar days established herein.

3. Delays to the Programmer caused by correction or troubleshooting of Contractor’s Work shall be grounds for an extension of the Owner’s Programming period a commensurate amount of time at no additional cost to the Owner.

C. The installation, programming, and testing of the Work requires considerable coordination between the Owner, Owner's SCADA Programmer, and the Contractor. The Contractor will provide on-site assistance through testing of the SCADA Programming.

D. Contractor shall provide on-site support during Owner's programming period to expedite system SCADA programming and testing. Contractor shall provide skilled labor capable of troubleshooting and making modifications to the various Work trades, including but not limited to mechanical, electrical, and instrumentation systems as necessary and within the Contract Document requirements. The Contractor shall be responsible for making any adjustments and/or modifications to the installation process that may become necessary to ensure that all equipment is properly installed.

E. Contractor (including the electrical contractor and control systems integrator) shall attend weekly controls coordination meetings with the SCADA Programmer, Owner, and Engineer at no additional cost to the Owner. Controls coordination meetings will be held during Initial Starting and Testing of Systems through completion of the Owner's Programming Period.

F. Upon completion of "Owner's Programming Period", Engineer shall issue a letter to Contractor titled: "Notice of Completed Owner Programming". Upon Notice of Completed Programming, Contractor shall commence with Acceptance Testing of Systems.

G. Owner's programmer shall be available for troubleshooting and coordination with Contractor during Acceptance Testing period.

3.5 ACCEPTANCE TESTING

A. Following completion of Contractor's Initial Starting and Testing Activities, Owner Training, and Owners Programming Period, and provided ancillary Work is sufficiently complete to permit operation of components (as determined by the Engineer), Acceptance Testing may begin.

B. At least fifteen calendar days prior to intended start date of Acceptance Testing of Systems, Contractor shall schedule a meeting with Owner and Engineer to review Contractor's plan for Acceptance Testing.

C. Acceptance Testing shall be performed in two phases to minimize disruption to the existing facility and to facilitate troubleshooting during testing.

1. Initial Acceptance Testing

    a. Shall be performed in a "closed-loop" for individual unit processes as defined by the Engineer.

    b. Initial Acceptance Testing shall use potable water for "closed-loop" testing.

c. Contractor shall provide all equipment, fuel, controls, piping, and other appurtenances as necessary for acceptance testing purposes in a closed-loop, including temporary items if necessary.

d. Demonstrate functional integrity under full operational conditions, including normal, alternate, and emergency conditions, as defined by the Engineer. Temporary pumping systems shall be capable of turn-down to simulate diurnal or other anticipated variation through the process, as required by the Engineer. The pumping system turn-down shall meet the intended operating flow regime for the unit process from 20% of peak flow through 100% of peak flow, unless specifically noted otherwise.

e. Period shall be a minimum of 7 calendar days with uninterrupted, continuous, and automatic operation (i.e., 24 hours a day), unless a longer period or more restrictive performance testing requirements are specified in a separate technical specification or Pre-Procured Equipment Contract Document.

f. Schedule Initial Acceptance Testing sequentially among Process Areas to allow for Owner and Engineer involvement with each system. Initial Acceptance Testing may only be scheduled concurrent with testing of another Process Area upon written approval by Owner and Engineer. Initial Acceptance Testing for all process areas shall be completed before Final Acceptance Testing begins.

g. Dates for the beginning and ending of Initial Acceptance Testing shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Initial Acceptance Testing Period.

h. If, during Initial Acceptance Testing, the aggregate amount of time used for repair, correction of incomplete work, alteration, or unscheduled adjustments to any equipment or system renders the affected equipment or system inoperative for more than 8 hours of the scheduled Acceptance Testing period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new Acceptance Testing Period shall commence after correction of the cause of failure. The new Acceptance Testing Period shall have the same requirements and duration as the Acceptance Testing Period previously conducted. Repairs, alterations, and adjustments, as well as failed and restarted Acceptance Testing periods shall be at no additional cost to the Owner and shall not be eligible for claims of delay by the Contractor.

2. Final Acceptance Testing

a. Upon successful completion of Initial Acceptance Testing, and approval by Owner and Engineer, Final Acceptance Testing may commence. Dates for the of beginning of Final Acceptance Testing shall be agreed upon by Contractor, Owner, and Engineer in advance of initiating Final Acceptance Testing Period.

b. Testing shall be performed "live" with influent flow to test and demonstrate operation and functionality of the system. Final Acceptance Testing shall not begin until after Initial Acceptance Testing has been successfully completed for all process areas.

c. Period shall be a minimum of 14 calendar days with uninterrupted, continuous, and automatic operation (i.e., 24 hours a day), unless a longer period or more restrictive performance testing requirements are specified in a separate technical specification or Pre-Procured Equipment Contract Document. Final Acceptance Testing shall not be concurrent with Initial Acceptance testing.

D. Demonstrate the operation, control, adjustment, and functional integrity of the process mechanical, mechanical, electrical, and control interfaces of the respective equipment and components comprising the facility or system.

E. Owner shall provide operational personnel to provide process decisions affecting plant performance during Owner's regular work hours. Owner's assistance shall only be available for process decisions. Contractor shall perform all other functions, including, but not limited to, equipment operation and maintenance throughout the Acceptance Testing period.

F. Owner and Engineer reserve the right to simulate operational variables, equipment failures, routine maintenance scenarios, etc. to verify the functional integrity of automatic and manual backup systems and alternate operating modes during Acceptance Testing. Should any simulation cause the system to fail or operate in an unsatisfactory manner, in the opinion of the Engineer or Owner, the Contractor shall be responsible for repairs and/or corrections.

G. Provide knowledgeable personnel to answer Owner's questions throughout the Acceptance Testing Period.

H. Provide field instruction on systems and respond to any system problems or failures that may occur.

I. Upon completion of Acceptance Testing, submit a certified report to Engineer (using the form inserted at the end of this specification and supplemented with manufacturer's checklists and forms) that the requirements are complete and that system is ready for Commissioning. Certificate shall be signed by Contractor and Manufacturer/Supplier.

3.6 COMMISSIONING

A. When adequate Training, Owner Programming, and successful Acceptance Testing of all systems within a Process Area is completed to the satisfaction of the Owner and Engineer, the Process Areas may be considered Commissioned.

B. Commissioning is defined as full integration of the equipment, including all electrical, controls, instrumentation, and all other support systems necessary for operation of the entire Process Area as designed.

C. Owner reserves the right to withhold payment on individual equipment items until such time as Commissioning may commence.

D. Submit a certified report to Engineer (using the form inserted at the end of this specification and supplemented with manufacturer's checklists and forms) stating that all preceding requirements have been completed and that the system is ready for Commissioning by Owner. Certificate shall be signed by Contractor and Manufacturer/Supplier.

E. Substantial Completion of the Work, or portions thereof, shall be no earlier than the date of completed Commissioning for the Process Areas.

3.7 OVERALL COMMISSIONING SEQUENCE

A. Reference Section 01 32 17 Work Sequence for coordination of process areas, including required predecessors and operational impacts. Not all components or support systems in the Work are shown or discussed. Contractor is responsible for developing an overall startup sequencing plan to meet the Contract requirements:

CONTRACTOR & MANUFACTURER/ SUPPLIER CERTIFICATE
Section 01 65 00 Commissioning of Systems
Initial Starting and Testing of Systems (Paragraph 3.2)

The following certificate shall be completed for each equipment item or system

Project Name _____ Equip Item/ Tag _____

Owner _____ Specification No. _____

Engineer _____ Serial No. _____

Contractor _____

Equip Mfg./ Supplier Start-up Representative and Contact Information:

Item No.	Description	Date Completed
1	(3.2.D) Conduct a meeting at least 10 working days prior to initial starting and testing of each item.	
2	(3.2.E.1) Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions that may cause damage	
3	(3.2.E.2) Verify wiring and support components for equipment are complete and have been previously tested.	
4	(3.2.E.3) Verify all instrumentation and controls are complete and have undergone testing in accordance with Division 26 requirements	
5	(3.2.D.4) Provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to initial starting and testing, and to supervise placing equipment or system in operation	
6	(3.2.G) Verify that tests, meter readings, and specified electrical characteristics agree with those required by Contract Documents and the equipment or system manufacturer	
7	(3.2.H) Execute initial starting and testing under supervision of responsible manufacturer’s representative and in accordance with manufacturers' instructions, recommendations, and requirements	
8	(3.2.J.1) Submit a certified report to Engineer that the requirements are complete.	

Observations/ Recommendations/ Comments:	
_____ MANUFACTURER/ SUPPLIER SIGNATURE	_____ DATE
_____ CONTRACTOR SIGNATURE	_____ DATE

CONTRACTOR & MANUFACTURER / SUPPLIER CERTIFICATE
Section 01 65 00 Commissioning of Systems
Operator / Owner Training (Paragraph 3.3)

The following certificate shall be completed for each equipment item or system.

Project Name _____ Equip Item/ Tag _____

Owner _____ Specification No. _____

Engineer _____ Serial No. _____

Contractor _____

Equip Mfg./ Supplier Start-up Representative and Contact Information:

Item No.	Description	Date Completed
1	(3.3.D) Provide a complete draft copy of the Preliminary Operation and Maintenance (O&M) Manuals for each of the Owner's operating personnel who attend the training.	
2	(3.3.D) Review contents of O&M manual with Owner's operating personnel in detail to explain all aspects of operation and maintenance.	
3	(3.3.D) Include the use of slides, videos, literature, diagrams, and/or oral presentations as necessary to present comprehensive, detailed instruction of operation and maintenance requirements of the equipment.	
4	(3.3.E) Upon satisfactory completion of the classroom training, continue training with a field training session utilizing the installed equipment. Equipment shall be run in all available control modes and sequences of operation.	
5	(3.3.G) Submit a certified report to Engineer that the requirements are complete and that system is ready for Commissioning.	

Observations/ Recommendations/ Comments:

_____ _____
MANUFACTURER/ SUPPLIER SIGNATURE DATE

_____ _____
CONTRACTOR SIGNATURE DATE

CONTRACTOR & MANUFACTURER/ SUPPLIER CERTIFICATE
Section 01 65 00 Commissioning of Systems
Notice of Completed Owner Programming (Paragraph 3.4)

The following certificate shall be completed for each equipment item or system

Project Name _____

Owner _____

Engineer _____

Contractor _____

Process Area/Equipment _____

Observations/ Recommendations/ Comments:
_____ _____ OWNER SIGNATURE DATE

CONTRACTOR & MANUFACTURER/ SUPPLIER CERTIFICATE
Section 01 65 00 Commissioning of Systems
Acceptance Testing of Systems (Paragraph 3.5)

The following certificate shall be completed for each equipment item or system

Project Name _____ Equip Item/ Tag _____

Owner _____ Specification No. _____

Engineer _____ Serial No. _____

Contractor _____

Equip Mfg./ Supplier Start-up Representative and Contact Information:

Dates of Initial Acceptance Testing: _____ to _____

Dates of Final Acceptance Testing: _____ to _____

Item No.	Description	Date Completed
1	(3.5.B) Schedule a meeting with Owner and Engineer 15 calendar days prior to intended start date of Acceptance Testing in order to review Contractor's plan for Acceptance Testing.	
2	(3.5.C.1.d) Conduct the demonstration of functional integrity under full operational conditions, including normal, alternate, and emergency conditions, as defined by the Engineer.	
3	(3.5.D) Demonstrate the functional integrity of the process mechanical, mechanical, electrical, and control interfaces of the respective equipment and components comprising the facility or system	
4	(3.5.G) Provide knowledgeable personnel to answer Owner's questions throughout the Demonstration Period	
5	(3.5.H) Provide field instruction on systems and respond to any system problems or failures that may occur	
6	(3.5.I) Submit a certified report to Engineer that the requirements are complete and the system is ready for Commissioning.	

Observations/ Recommendations/ Comments:

_____ _____
MANUFACTURER/ SUPPLIER SIGNATURE DATE

_____ _____
CONTRACTOR SIGNATURE DATE

CONTRACTOR & MANUFACTURER/ SUPPLIER CERTIFICATE
Section 01 65 00 Commissioning of Systems
Commissioning of Systems (Paragraph 3.6)

The following certificate shall be completed for each equipment item or system

Project Name _____ Equip Item/ Tag _____

Owner _____ Specification No. _____

Engineer _____ Serial No. _____

Contractor _____

Equip Mfg./ Supplier Start-up Representative and Contact Information:

Item No.	**Description**	**Date Completed**
1	(3.6.D) Submit a certified report to Engineer that all preceding requirements have been completed and that the system is ready for commissioning by Owner.	
Observations/ Recommendations/ Comments:		
Certification by Manufacturer/Supplier and Contractor		
_____ MANUFACTURER/ SUPPLIER SIGNATURE		_____ DATE
_____ CONTRACTOR SIGNATURE		_____ DATE
Acceptance by Owner		
_____ OWNER'S SIGNATURE		_____ DATE

TRAINING OUTLINE

Below is a basic training outline stating the general requirements that are to be provided with each training listed in Section 01 65 00 Commissioning of Systems.

A. General Description

Classroom: Provide a basic description of the overall equipment system function and operation. Identify the major components of the equipment system. (i.e., for a pump system: motor, drive, pump, instrumentation, and controls). Provide a general description of equipment functional capacities (i.e., for a pump system: pumping capacity and maximum/minimum ranges, and reverse operation if applicable, etc.). Review the organization of the Preliminary O&M Manual and the general contents of each section.

B. Equipment System Components

Classroom: Identify by name and location the components that make up the equipment system. In the classroom use photos or videos that clearly identify the components. Provide a functional description of what each component does in the operation of the equipment system. (i.e., proximity switch provides feedback for rotation of equipment by sensing a metal bar passing through the switch magnetic field). Describe each component's inputs, outputs, normal and abnormal conditions, safety issues, routine maintenance and disassembly/reassembly of the component.

Field training: Repeat the classroom information in the field clearly identifying components by touching or pointing to them.

C. Equipment System Function & Operation

Classroom: Describe how each equipment system component contributes to the function and operation of the equipment system. Discuss equipment system checkout prior to operation, equipment startup, routine operation, abnormal operation, remote operation, equipment shut down, and emergency conditions. Provide methods to obtain the most efficient equipment system operation. Discuss troubleshooting abnormal operating conditions and typical solutions. Alarm conditions shall be described as to the causes, solutions, and effects on the equipment system.

Field Training: Repeat the classroom information applying it to the installed equipment. Direct the Owner's personnel in the step-by-step procedures required to operate the equipment system properly. Perform normal operational checks to verify proper operation. Identify conditions and indications of improper operation. Provide training on how the automatic operating controls function and adjustments available to the operators. Provide

training on how the manual operating controls function and adjustments available to the operators.

D. Equipment System Maintenance

Classroom: Describe and discuss the routine and preventative maintenance activities and associated procedures. Use the Preliminary O&M manual to identify the lubricants needed and their proper application. Use video or pictures to provide classroom training on equipment disassembly and reassembly for the replacement of components. Discuss the equipment system spare parts needed and the sources for the spare parts.

Field training: Review the classroom information, including disassembly and reassembly of the equipment system and its components. Manufacturer's representative shall disassemble and reassemble equipment to demonstrate the procedure. Such disassembly and reassembly shall not void the manufacturer's warranty.

E. Equipment System Safety

Classroom: Identify all safety issues with the equipment system: mechanical, electrical, chemical, and any other safety items. Provide step-by-step procedures to control the safety hazards.

Field training: Review the classroom information for the equipment system mechanical, electrical, chemical, and other safety items. Provide hands-on training of step-by-step safety procedures.

END OF SECTION

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SECTION 01 70 00
CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout Procedures

B. Final Cleaning

C. Project Record Documents

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been reviewed, and that Work is complete in accordance with Contract Documents and ready for review by the Engineer and Owner.

B. Submit Warranty certificates.

C. Provide submittals to Engineer that are required by governing, funding or other authorities.

D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

A. Execute final cleaning prior to requesting Final Inspection by the Engineer.

B. Clean site, including, but not limited to, the following. Site shall be clean, in the opinion of the Owner, before Final Payment will be issued.

1. Sweep paved and concrete surfaces. Sweep and wash interior floors.

2. Clean and disinfect all sanitary facilities constructed by Contractor's personnel during the course of the Work.

3. Clean debris from drainage systems.

4. Clean all windows and other glass surfaces, interior and exterior.

5. Remove temporary labels, stains, and foreign substances.

6. Vacuum soft surfaces.

7. Remove debris from gutters.

8. Clean debris from the interior of electrical cabinets, junction boxes, MCCs…etc.

9. Remove waste and surplus materials, rubbish, and construction facilities from the site.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01 73 00
INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 DESCRIPTION

A. Description of Work

1. Provide Installation, Preliminary, and Final Operation and Maintenance (O&M) Manuals for use by the Contractor and the Owner.

2. Installation Manuals, as well as Preliminary and Final O&M Manuals shall be provided for all equipment incorporated into the Work. Manufacturer's Instructions shall be submitted for all other products. Reference Section 01 33 00 Submittal Procedures. Installation Manuals and/or Manufacturer's Installation Instructions shall be maintained at the job site.

3. The term "Operation and Maintenance Manual" includes all product-related information and documents that are required herein, as well as data that is required for inclusion by current regulations of any participating government agency or as a provision of a system warranty.

4. Required delivery schedule for Installation and O&M Manuals is as follows:

   a. Installation Manuals are due a minimum of 30 days before individual Goods are delivered to the project.

   b. Preliminary O&M Manuals are due a minimum of 30 days before Initial Starting and Testing (reference Section 01 65 00 Commissioning of Systems).

   c. Final O&M Manuals are due 30 days after the completion of Final Acceptance Testing. Final payment will not be made until all O&M Manuals are complete and noted as "no exceptions taken" by the Engineer.

B. The Installation Manual shall include, at minimum, the following:

1. The Project's established tag and descriptive name for each product and component, as well as the manufacturer's serial number. The use of cryptic model or catalog numbers or letters for identification shall not be acceptable.

2. Manufacturer's instructions for delivery, storage, assembly, and installation.

3. Name, address, telephone number, and email for manufacturer and manufacturer's local service representative.

C. The O&M Manual shall include, at minimum, the following:

1. Equipment description, including equipment function, operating characteristics, limiting operating conditions (minimum, average, and maximum input, output, temperatures, speeds, and production limits… etc.).

2. Equipment operating instructions and procedures for startup, normal and emergency conditions, shutdown, and storage.

3. Photos or diagrams of equipment shall identify each component comprising the equipment. Provide description and function information for each component.

4. Equipment safety considerations relating to storage, handing, installation, operation, and maintenance procedures.

5. Installation procedures.

6. Calibration procedures, or a statement that calibration is not required.

7. Routine and preventive maintenance instructions for all maintenance activities, including instructions to keep equipment properly lubricated, adjusted, and maintained so that the item functions as intended throughout its full design life. Routine and preventive maintenance instructions shall include, but not limited to, the following:

a. Written explanations with illustrations or photographs for each preventive maintenance task.

b. Recommended schedule for execution of preventive and routine maintenance tasks.

c. Lubrication charts including a table of alternative lubricants naming at least two alternate lubricant manufacturers, with applicable product numbers, for each application.

d. Troubleshooting instructions.

e. List of required maintenance tools and equipment.

f. Procedures for disassembly, reassembly, alignment, adjustment, and inspection instructions. Instructions shall include photographs and/or video of the stages of the procedures. Provide photos or diagrams which indicate alignment and adjustment equipment/component locations.

g. Recommended spare parts list to maintain equipment in service. Include serial numbers and other pertinent ordering information.

h. Special Tools: For equipment, provide a list of special tools, materials, and supplies included and required for installation, checking, testing, parts replacement, and maintenance.

i. Name, address, and telephone number for local sources of equipment and/or replacement parts.

j. Name, address, telephone number, and email for manufacturer and manufacturer's local service representative.

k. Material Safety Data Sheets (SDS) for any applicable item (chemicals, oils, lubricants, etc.) provided by the supplier. SDS shall be in the standard 16-section format as described under the Hazard Communication Standard (29 CFR 1910.1200(g) and 29 CRF 1910.1200 Appendix D).

l. Warranty Information, Bond(s), and Service contract(s), if applicable. Warranty periods shall be as required by the Contract Documents.

m. Project-specific tag number, and the associated manufacturer's model and serial number for the equipment provided.

n. Factory Test Reports, if required per the equipment-specific technical specification.

o. Commissioning Test Reports shall be included in the Final O&M Manual, including:

8. Results of all installation inspection, field calibration, and field-testing reports prepared during the commissioning of the facility.

9. Results of Acceptance Testing.

    i. "No exceptions taken" shop drawings (including equipment drawings, schematics, circuit diagrams).

    ii. Non-Project-Related Information Deleted: Non-project-related components, information, descriptions, or other reference information shall be deleted or crossed out or otherwise deleted. Indicate all components of the equipment on catalog pages by bold markings or some other clearly definable medium for ease of identification. All markings shall be readable if photocopied.

D. Coordination: The Contractor shall coordinate the delivery and incorporation of all O&M Manuals prepared for this project from their component equipment suppliers.

E. If applicable, the Contractor shall develop an O&M Manual for the equipment and systems designed and provided by the Contractor under this contract.

1.2 SUBMITTALS

A. Installation Manuals and Preliminary O&M Manuals shall be submitted digitally per Section 01 33 00.

B. Final O&M Manuals shall be submitted per Section 01 33 00 as a digital copy and as hardcopies in three ring binders. The Final O&M shall be an updated version of the Preliminary O&M Manual. Contractor shall prepare and insert additional data in the Final O&M when the need for additional data becomes apparent during Operator/Owner Training, or as otherwise deemed necessary by the Engineer. Contractor shall indicate in their transmittal all modifications made from the Preliminary O&M and on which pages those modifications can be found. Contractor shall provide additional information as part of the transmittal detailing how these modifications reflect the as-built conditions.

1. Final O&M Hardcopies shall meet the following requirements:

   a. The table of contents shall be included in each volume of multi-volume manuals.

   b. Manuals shall use dividers and indexed tabs for each section or item delineated in the table of contents. Dividers shall be cardstock or plastic.

   c. Manuals shall use 8½-inch by 11-inch acid free paper of high rag content and quality. All text must be legible, type-written or machine printed originals or high-quality copies. Paper shall be white.

   d. Each page shall have a binding margin of approximately 1½ inches and be punched for placement in a three-ring “D” style loose-leaf binder, which shall be provided by the Contractor along with the submittal. Each binder shall be no more than 3 inches. Binders for a single manual shall be all of the same color.

   e. Drawings provided as part of the Final O&M Manual shall be half-size black line (11” x 17”) reproductions.

2. Provide three (3) hard copies of the Final O&M Manuals. Contractor shall deliver the O&M manuals directly to Owner.

3. Final O&M Digital Copies shall be in PDF format and satisfy the requirements of Section 01 33 00 Submittal Procedures. The document shall include bookmarks

corresponding to the hard-copy dividers and be completely searchable. A copy of the digital Final O&M shall be included on a USB inside of the hardcopy binder.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 03 01 00
MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. All concrete on the project shall be maintained in good and acceptable condition until the warranty period is completed. Until the end of the specified warranty period, concrete deemed by the Engineer to be unacceptable shall be repaired per this section or as directed by the Engineer.

B. Section Includes:

1. Submittals
2. Closeout Submittals
3. Quality Assurance
4. Qualifications
5. Delivery, Storage, and Handling
6. Examination
7. Preparation
8. Repair Work
9. Injection – Epoxy Resin
10. Application – Epoxy Mortar
11. Application Cementitious Mortar
12. Field Quality Control

C. Related Sections:

1. Section 01 20 00 – Measurement and Payment
2. Section 03 30 00 – Cast-In-Place Concrete

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

2. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

3. ASTM C33 - Standard Specification for Concrete Aggregates.

4. ASTM C109 - Standard Test Method for Compressive strength of Hydraulic Cement Mortars (Using 2-in. or (50 mm) Cube Specimens).

5. ASTM C150 - Standard Specification for Portland Cement.

6. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

7. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).

8. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.

9. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

10. ASTM C1042 - Standard Test Method for Bond Strength of Latex Systems Used With Concrete By Slant Shear.

11. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.

12. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

13. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

B. American Welding Society (AWS):

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures

B. Product Data: Submit product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.

C. Manufacturer’s Instructions: Submit mixing instructions.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 –Closeout Requirements: Closeout procedures

B. Project Record Documents: Accurately record actual locations of structural reinforcement repairs, type of repair, and procedures.

C. Operation and Maintenance Data: Procedures for submittals

1.5 QUALITY ASSURANCE

A. Perform welding work in accordance with AWS D1.4.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in concrete repair with minimum three years documented experience or approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements

B. Comply with instructions for storage, shelf-life limitations, and handling.

PART 2 PRODUCTS

2.1 EPOXY ADHESIVE INJECTION MATERIALS

A. Epoxy Adhesive: Two-part epoxy adhesive containing 100 percent solids, meeting the following minimum characteristics:

Characteristic	Test Method	Results
Bond Strength	ASTM C882	2,700 psi
Tensile Strength	ASTM D638	6,600 psi
Elongation	ASTM D638	2 percent at 7 days 70˚F
Flexural Strength	ASTM D790	8,000 psi
Compressive Strength	ASTM D695	6,500 psi

2.2 EPOXY MORTAR MATERIALS

A. Epoxy Mortar: Three-part epoxy binding resin and aggregate mortar mixture.

B. Epoxy Binding Resin: Two-part epoxy resin containing 100 percent solids, meeting the following minimum characteristics:

Characteristic	Test Method	Results
Bond Strength	ASTM C882	2,700 psi
Tensile Strength	ASTM D638	6,600 psi
Elongation	ASTM D638	2 percent at 7 days 70˚F
Flexural Strength	ASTM D790	8,000 psi
Compressive Strength	ASTM D695	6,500 psi

C. Aggregate: Type recommended by mortar manufacturer.

2.3 CEMENTITIOUS MORTAR MATERIALS

A. Cementitious Mortar: Packaged Portland cement patching mortar with the following properties:

1. Compressive Strength: ASTM C109; minimum 2,000 psi after one day and 5,000 psi after 28 days.

2. Bond Strength: ASTM C882; minimum 1,400 psi after 28 days

3. Flexural Strength; ASTM C293; minimum 1,500 psi after 28 days

B. Water: Clean and potable

C. Calcium Chloride: Not permitted

D. Bonding Agent: Polyvinyl acetate emulsion, dispersed in water while mixing, non-coagulant in mix, water resistant when cured.

E. Cleaning Agent: Commercial muriatic acid

2.4 REINFORCEMENT MATERIALS

A. Per Section 03 20 00 – Concrete Reinforcement

2.5 MIXING EPOXY MORTAR

A. Mix epoxy mortars to consistency for purpose intended.

B. Mix components in clean equipment or containers. Conform to pot life and workability limits.

2.6 MIXING CEMENTITIOUS MORTAR

A. Mix cementitious mortar to consistency required for purpose intended.

B. Include bonding agent as additive to mix.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify surfaces are ready to receive work.

B. Beginning of installation means acceptance of substrate.

3.2 PREPARATION

A. Clean concrete surfaces of dirt, laitance, corrosion, or other contamination; wire brush using water; rinse surface and allow to dry.

B. Flush out cracks and voids with water to remove laitance and dirt.

C. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than depth of crack to be filled or port size diameter no greater than thickness of crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

D. For areas patched with epoxy mortar, remove broken and soft concrete 1/4 inch deep. Remove corrosion from steel. Clean surfaces mechanically; wash with acid; rinse with water.

E. Sandblast clean exposed reinforcement steel surfaces. Mechanically cut away damaged portions of bar.

3.3 REPAIR WORK

A. Repair reinforcement as directed by Engineer to meet or exceed original stress values.

B. Repair exposed structural, shrinkage, and settlement cracks of concrete by epoxy injection method.

C. Repair pockets, voids, or spalling. Fill voids flush with surface. Apply surface finish.

3.4 INJECTION - EPOXY RESIN

A. Inject epoxy resin adhesive into prepared ports under pressure using equipment appropriate for the application.

B. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.

C. Remove temporary seal and excess adhesive.

D. Clean surfaces adjacent to repair and blend finish.

3.5 APPLICATION - EPOXY MORTAR

A. Trowel applies mortar mix to required surface. Tamp into place filling voids at spalled areas.

B. For patching honeycomb, trowel mortar onto surface, work mortar into honeycomb to bring surface flush with surrounding area. Finish trowel surface to match surrounding area.

C. Cover exposed steel reinforcement with epoxy mortar, feather edges to flush surface.

3.6 APPLICATION - CEMENTITIOUS MORTAR

A. Apply spray or brush coating of bonding agent to damp concrete surfaces. Provide full surface coverage.

B. Apply cementitious mortar by steel trowel to required surface. Tamp into place filling voids at spalled areas. Work mix into honeycomb.

C. Damp cure cementitious mortar for **four** days.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Assurance and Quality Control: Testing, inspection, and analysis requirements.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Design Requirements
2. Submittals
3. Quality Assurance
4. Qualifications
5. Delivery, Storage, and Handling
6. Coordination
7. Examination
8. Installation
9. Application – Form Release Agent
10. Installation – Inserts, Embedded Parts, and Openings
11. Form Cleaning
12. Form Removal
13. Erection Tolerances
14. Field Quality Control

B. Related Sections:

1. Division 1
2. Division 3
3. Division 5

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials
2. ACI 301 - Specifications for Structural Concrete
3. ACI 318 - Building Code Requirements for Structural Concrete
4. ACI 347 - Guide to Formwork for Concrete

B. American Forest and Paper Association (AF&PA):

1. AF&PA - National Design Specifications for Wood Construction

C. APA – The Engineered Wood Association (EWA):

1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood

D. ASTM International (ASTM):

1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials

E. West Coast Lumber Inspection Bureau (WCLIB):

1. WCLIB - Standard Grading Rules for West Coast Lumber

1.3 DESIGN REQUIREMENTS

A. Design, engineer, and construct formwork, shoring and bracing in accordance with ACI 318 to conform to design and applicable code requirements to achieve concrete shape, line, and dimension as indicated on Drawings.

1. Engineered Design required for the following systems:
    a. Elevated structural concrete slabs, beams, and joists.
    b. Walls greater than eight feet in height.

1.4 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Signed and sealed by professional engineer.

1. Submit formwork, shoring, and re-shoring shop drawings.
2. Indicate the following:
    a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding, and bracing, and temporary supports.
    b. Means of leakage prevention for concrete exposed to view in finished construction.
    c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement.
    d. Vertical, horizontal, and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.

e. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318, Section 6.3.

f. Procedure and schedule for removal of shores and installation and removal of re-shores.

C. Product Data: Submit data on void form materials and installation requirements.

D. Design Data: Signed and sealed by a professional engineer.

1. Indicate design data for formwork and shoring.

2. Indicate loads transferred to structure during process of concreting, shoring, and re-shoring.

3. Include structural calculations to support design.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI 347.

B. For wood products furnished for work of this Section, comply with AF&PA.

1.6 QUALIFICATIONS

A. Design formwork under direct supervision of professional engineer experienced in design of this Work and licensed at Project location.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 1: Products storage and handling requirements.

B. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.8 COORDINATION

A. Division 1: Coordination and project conditions.

B. Coordinate this Section with other Sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Softwood Plywood: APA/EWA PS 1, C Plugged Grade, Group 3.

B. Lumber Forms:

1. Application: Use for edge forms and unexposed finish concrete.

2. Boards: Six inches or eight inches in width, shiplapped or tongue and groove, "Standard" Grade Douglas Fir, conforming to WCLIB Standard Grading Rules for West Coast Lumber. Surface boards on four sides.

C. Plywood Forms:

1. Application: Use for exposed finish concrete.

2. Forms: Conform to PS 1; full size four foot by eight-foot panels; each panel labeled with grade trademark of APA/EWA.

3. Plywood for Surfaces to Receive Membrane Waterproofing: Minimum of 5/8-inch thick; APA/EWA "B-B Plyform Structural I Exterior" grade.

4. Plywood where "Smooth Finish" is required, as indicated on Drawings: APA/EWA "HD Overlay Plyform Structural I Exterior" grade, minimum of 3/4 inch thick.

2.2 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gauge matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, sizes.

D. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.

E. Form Liners: Smooth, durable, grainless and non-staining hardboard, unless otherwise indicated on Drawings.

F. Framing, Studding, and Bracing: Stud or No. 3 structural light framing grade.

2.3 FORMS FOR CURVED WALLS

A. All curved walls as indicated on the project drawings shall be formed with curved, prefabricated forms constructed to match the radial lines, interior and exterior, of the walls as indicated on the plans.

2.4 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, galvanized metal, fixed or adjustable length, cone type, with waterproofing washer, one inch back break dimension, free of defects capable of leaving holes larger than one inch in concrete surface.

B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within one inch of concrete face. Wire ties, wood spreaders, or through bolts are not permitted.

C. Form Anchors and Hangers:

1. Do not use anchors and hangers on exposed concrete leaving exposed metal at concrete surface.

2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.

3. Penetration of structural steel members is not permitted.

D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

E. Corners: Fillet or Chamfer with rigid plastic or wood strip, dimensions as indicated on the drawings; maximum possible lengths.

F. Bituminous Joint Filler: ASTM D1751.

G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

2.5 COATINGS

A. Coatings for Aluminum: Polyamide epoxy finish coat with paint manufacturer's recommended primer for aluminum substrate. Apply one coat primer and one coat finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 1: Coordination and project conditions.

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

C. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Engineer.

3.2 INSTALLATION

A. Earth Forms:

1. Earth forms are not permitted, except for concrete encasement of pipes and conduits and as specifically indicated on the drawings.

B. Formwork - General:

1. Provide top form for sloped surfaces steeper than one and a half horizontal to one vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.

C. Forms for Smooth Finish Concrete:

1. Use steel, plywood, or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

D. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

E. Framing, Studding and Bracing:

1. Space studs at 16-inch center maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of two inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement, or accidental impact.

F. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

G. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

H. Obtain Engineer's approval before framing openings in structural members not indicated on Drawings.

I. Install fillet and chamfer strips on external corners of beams, joists, columns, and other members as indicated on the drawings.

J. Install void forms in accordance with manufacturer's recommendations.

3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

H. Form Ties:

1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least one inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless otherwise shown on Drawings.

I. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true, and sharp.

K. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Specification sections.
4. Securely anchor embedded items into the correct location and alignment prior to placing concrete.
5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 for size and location limitations.

L. Openings for Items Passing Through Concrete:

1. Frame openings in concrete as indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

M. Screeds:

1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.

2. Slope slabs to drain where required or as shown on Drawings.

3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

N. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle, pad, or base type screed supports which will not puncture membrane.

2. Staking through membrane is not permitted.

O. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at the bottom of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.

2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust, and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by the Engineer.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

D. Removal of forms shall be as indicated in the drawings. Contractor shall provide sampling and testing for compressive strength as necessary to justify the time for form removal. Such sampling and testing shall occur separate from Owner-provided special inspections and the cost shall be borne by the Contractor. Submit test reports to the Engineer.

3.7 ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

B. Camber slabs and beams 1/8 inch per 10 feet in accordance with ACI 301.

3.8 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Assurance and Quality Control: Field inspecting, testing, adjusting, and balancing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals

B. Quality Assurance

C. Coordination

D. Placement

E. Field Quality Control

1.2 RELATED SECTIONS

A. Division 1

B. Division 3

C. Division 5

1.3 REFERENCES

A. American Concrete Institute (ACI) 301 - Structural Concrete for Buildings

B. ACI 315 – Manual of Standard Practices for Detailing Concrete Structures

C. ACI 318 - Building Code Requirements for Reinforced Concrete

D. ACI 350 - Environmental Engineering Concrete Structures

E. ACI SP-66 - American Concrete Institute - Detailing Manual

F. American National Standards Institute (ANSI)/ASTM International (ASTM) A82 - Cold Drawn Steel Wire for Concrete Reinforcement

G. ANSI/ASTM A184 - Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

H. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement

I. ANSI/ASTM A496 - Deformed Steel Wire Fabric for Concrete Reinforcement

J. ANSI/ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement

K. ANSI/American Welding Society (AWS) D1.4 - Structural Welding Code for Reinforcing Steel

L. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement

M. ASTM A704 - Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement

N. ASTM A706 - Low-Alloy Steel Deformed Bars for Concrete Reinforcement

O. AWS D12.1 - Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction

P. Concrete Reinforcing Steel Institute (CRSI) – Manual of Practice

Q. CRSI 63 - Recommended Practice for Placing Reinforcing Bars

R. CRSI 65 - Recommended Practice for Placing Bar Supports, Specifications and Nomenclature

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Shop Drawings:

1. Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric bending and cutting schedules, and supporting and spacing devices, if dissimilar from Drawings.

2. Indicate dimensions, materials, bracings, and arrangement of joints and ties.

C. Submit plan for placement of all concrete walls four weeks prior to placement.

D. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

E. Indicate locations of all construction joints prior to concrete placement.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, ACI 315, ACI 318, and ACI 350.

B. Maintain one copy of each document on site.

C. Submit certified copies of mill test report of reinforcement materials analysis.

1.6 COORDINATION

A. Coordinate work under provisions of Section 01 30 00 – Coordination and Meetings.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 kilo pounds per square inch (ksi) yield grade; deformed billet steel bars (#3 bars may be grade 40 ksi), unfinished, free of dirt, oil, grease, loose scale or other substances that might reduce development of the bond strength.

B. Reinforcing Steel Mat: ASTM A704, ASTM A615, 60 ksi yield grade; steel bars or rods, unfinished.

C. Stirrup Steel: ANSI/ASTM A82, unfinished.

D. Welded Steel Wire Fabric: ASTM A185 Plain Type, or ASTM A496 Welded Deformed Type; in coiled rolls.

E. Mechanical Rebar Splicing Devices: Where indicated on the drawings, provide mechanical threaded dowel rebar splicing devices of the size type, spacing and placement indicated. The system shall be a standard two-piece threaded coupler system, with the first piece consisting of a dowel with integral female-threaded head which will accept the 2nd (future or second phase placement) male threaded dowel section. The first piece shall have an integral flat surfaced, flush mounted flange allowing for attachment to the pour stop forming in such a manner as to securely hold the device in place.

1. Mechanical splices shall meet the Acceptance Criteria of ICC Evaluation Services report AC133.
2. Mechanical Splice shall conform to Type 1 requirements and develop 100 percent of the specified ultimate strength of the bar being spliced.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16-gauge annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with ACI 318 and ACI 350.

B. Locate reinforcing splices not indicated on drawings, at point of minimum stress.

2.4 EMBEDMENT ANCHORS

A. Simpson SET high-strength epoxy system or Hilti, HVA epoxy embedment anchors. Refer to notes or specifications for Concrete Doweling or Field-set dowels and anchors.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support, and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor barrier/retarder.

C. Accommodate placement of formed openings.

D. Conform to ACI 350 for concrete cover over reinforcement.

E. Splice all bars with a minimum lap of 32 bar diameters unless otherwise noted on the Drawings.

F. Reinforcement steel shall have the concrete cover noted on the Drawings.

G. Metal clips or supports holding the reinforcement shall not be placed in contact with the forms or the subgrade.

H. Secure and support reinforcement and dowels in position with wire or other approved methods. Shoving reinforcement or dowels into freshly poured concrete is prohibited.

3.2 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Section 01 40 00.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal

B. Project Record Documents

C. Quality Assurance

D. Field Samples

E. Coordination

F. Examination

G. Preparation

H. Placing Concrete

I. Concrete Finishing

J. Curing and Protection

K. Field Quality Control

L. Patching

M. Defective Concrete

1.2 RELATED SECTIONS

A. Division 1

B. Division 3

1.3 REFERENCES

A. American Concrete Institute (ACI) 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete

B. ACI 301 - Structural Concrete for Buildings

C. ACI 302 - Guide for Concrete Floor and Slab Construction

D. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete

E. ACI 305R - Hot Weather Concreting

F. ACI 306R - Cold Weather Concreting

G. ACI 308 - Standard Practice for Curing Concrete

H. ACI 318 – Building Code Requirements for Reinforced Concrete

I. ACI 350R – Environmental Engineering Concrete Structures

J. American National Standards Institute (ANSI)/ASTM International (ASTM) D994 - Preformed Expansion Joint Filler for Concrete (Bituminous Type)

K. ANSI/ASTM D1190 - Concrete Joint Sealer, Hot-Poured Elastic Type

L. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

M. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

N. ASTM C31 - Making and curing concrete test specimens in the field

O. ASTM C33 - Concrete Aggregates

P. ASTM C39 - Compressive strength of cylindrical concrete specimens

Q. ASTM C94 - Ready-Mixed Concrete

R. ASTM C150 - Portland Cement

S. ASTM C260 - Air Entraining Admixtures for Concrete

T. ASTM C494 - Chemicals Admixtures for Concrete

U. ASTM C1260 - Standard Test Method for Potential Reactivity of Aggregates (Mortar-Bar Method)

V. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

W. ASTM C1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

V. American Association of State Highway and Transportation Official (AASHTO) PP65 - – Standard Practice for Determining the Reactivity of Concrete Aggregates.

1.4 SUBMITTAL

A. Submit under provisions of Section 01 33 00.

B. Product Data: Provide data on joint devices, attachment accessories, admixtures, aggregate, and cement.

C. Samples: Submit two-inch long samples of contraction joint and control joint.

D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent work.

E. Submit mix design and certification of compliance for all admixtures and curing compounds

F. Submit aggregate source classification for the Akali-Silica Reaction (ASR).

G. Mitigation for aggregate Akali-Silica Reaction (ASR).

1. For aggregate source with non-reactive materials. Submit verification that selected source of aggregate is not susceptible to ASR within the proposed concrete mix designs for this project. Aggregate shall be classified R0 (Non-reactive).
2. For aggregate source with moderately reactive materials; aggregates classified R1. Submit verification that the proposed mix design, with the specific aggregate source selected, has been designed through the addition of appropriate amounts of Fly Ash or other accepted additives to mitigate ASR. Provide test results proving effectiveness of mix design per ASTM C 1567.
3. For aggregate source with highly or very-highly reactive materials, aggregates classified R2 or R3. Mix designs with moderately or highly reactive materials shall not be permitted for use on this project.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 70 00.

B. Accurately record actual locations of embedded utilities and components which are concealed from view.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cement and aggregate from same source for all work.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

1.7 FIELD SAMPLES

A. Provide under provisions of Section 01 40 00.

1.8 COORDINATION

A. Coordinate work under provisions of Section 01 30 00 – Coordination and Meetings.

B. Coordinate the placement of joint devices with erection of concrete form work and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I, or II.

B. Fine and Coarse Aggregates: ¾-inch maximum aggregate per ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260; manufactured by Grace Daravair `M' or SIKA Chemical `AER'.

B. Water Reducers: ASTM C494, Type F or G.

C. Super-Plasticizer: High-Range Water Reducing (HRWR) admixture conforming to ASTM C494.

D. Fly Ash; ASTM C618.

2.3 ACCESSORIES

A. Bonding Agent: Two component modified epoxy resin.

B. Non-Shrink Grout: Per Section 03 60 00 – Grouting.

C. Epoxy/Grout Adhesive:

1. Three Component Epoxy Resin System:
   - Two liquid epoxy components.
   - One inert aggregate filtered component.
   - Each component furnished in separate package for mixing at job site.
2. Apply only to clean, dry, sound surface.
3. Mix and place in accordance with manufacturer’s instructions.
4. Completely fill all cavities and spaces around dowels and anchors without voids.

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler Type A: ASTM D1751; Asphalt impregnated fiberboard or felt, ½-inch thick; tongue and groove profile.

B. Joint Filler Type B: ASTM D1752; Closed cell polyvinyl chloride foam, resiliency recovery of 95 percent if not compressed more than 50 percent of original thickness.

C. Construction Joint Devices: Integral extruded plastic; 3/8-inch thick, formed to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at six inches, ribbed steel spikes with tongue to fit top screed edge.

D. Contraction Joint Devices: ASTM B221 resilient elastomeric or neoprene filler strip with a Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; of longest manufactured length at each location, flush mounted.

E. Sealant: Elastomeric sealant conforming to ASTM C920 and Federal Specification TT-S-00277E. In all joints for liquid-retaining structures provide sealants specially formulated to conform to Use Requirement I, for submerged conditions.

F. Moisture-activated Strip Waterstop: Continuous water-activated strip joint water-stop noted on the Drawings as “Swell-seal” or “Swellstop” water-stop shall be a flexible butyl rubber and swellable clay waterproofing compound in the dimensions called for on the Drawings. Provide “Swellstop” by Greenstreak, Inc. or an approved equal.

G. Flexible Waterstops: Polyvinyl chloride (PVC), minimum 2,000 pounds per square inch (psi) tensile strength with a minimum working temperature range of plus 35°F to plus 175°F. Conform to ASTM D570, D746, D1149 and CRD-C572.

Provide profile, type, and width as indicated on the drawings in maximum possible lengths with pre-formed corner, joint and intersection pieces fully heat-welded or glued together as approved by the manufacturer to form a water-tight system.

2.5 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Alternative Number 1.

B. Provide concrete mix designs as noted under “Project Concrete Mix Types” in the Structural Materials Section of the General Structural Notes and Specifications included on the Structural Project Sheets.

C. Use accelerating admixtures in cold weather only when approved by Engineer. Use of admixtures will not relax cold weather placement requirements.

D. Do not use calcium chloride.

E. Use set retarding admixtures during hot weather only when approved by Engineer.

F. A water-reducing admixture conforming to ASTM C494 used in strict conformance with the manufacturer's specifications shall be incorporated in all concrete mix designs. For all water-retaining structures, a high-range water-reducing admixture conforming to ASTM C494 Type F or G, shall be used. Total slumps shall not exceed 10 inches and the water-cement ratios listed is not exceeded. W/C ratio listed refers to the total cement plus fly ash content.

G. When Alkali-Silica Reactive aggregate is used the design mix shall provide for mitigation of ASR.

2.6 CONCRETE BONDING ADHESIVE

A. Concresive liquid bonding adhesive (LPL) two-component, liquid epoxy bonding agent.

B. No substitutes.

2.7 FLEXIBLE WATERSTOP

A. Waterstop noted as flexible or PVC on the Drawings shall be compounded from polyvinyl chloride (PVC) and shall have the following properties:

1.	Minimum Ultimate Elongation	250 Percent
2.	Minimum Tensile Strength	2,000 psi
3.	Brittle Temperature	-23° F
4.	Shore Durometer Type "A" Hardness	80, approximately
5.	Specific Gravity	1.3, approximately

B. Waterstop shall be uniform in dimensions, homogeneous and free from porosity. Minimum thickness shall be one-quarter (1/4) inch and minimum width of six (6) inches unless otherwise shown on the Drawings. Waterstop shall be ribbed center bulb type.

C. Corrugated type waterstops are not acceptable.

2.8 CONTROLLED LOW STRENGTH MATERIAL (CONTROLLED DENSITY FILL)

A. Lean concrete mix for use under foundations and slabs on grade shall meet the following design criteria:

1. Mix type M-CDF as follows: A mixture of cement, fine sand, course aggregate, fly ash and admixtures formulated to be flowable and self-consolidating with a net 28-day compressive strength of 200 to 300 psi.

2.9 MISCELLANEOUS SITE CONCRETE

A. Miscellaneous site concrete such as concrete thrust blocks, guard post bases and fence post bases shall meet the requirements of Mix M2500-SEC as noted in General Structural Notes and Specifications unless specifically noted otherwise on the Contract Drawings.

2.10 MISCELLANEOUS CONCRETE PADS

A. Miscellaneous concrete pads such as thrust blocks, valley gutter, exterior pads at doorways, valve box collars, etc. shall meet the requirement of Concrete Mix M4500-STD as noted in the General Structural Notes and Specifications unless specifically noted otherwise on the Contract Drawings.

2.11 FOUNDATIONS AND STRUCTURAL CONCRETE

A. As noted in the General Structural Notes and Specifications, as shown on the Drawings.

1. M4500-STD for concrete footings, walls, elevated slabs, beams, and columns
2. M4500-SPS (Super-Plasticized Concrete) for concrete footings, walls and slabs used in water-containing structures.

2.12 SLURRY MIXTURE

A. M-SLURRY as follows: A flow-able mix for use at the bottom of horizontal wall construction joints consisting of sand, 3/8-inch aggregate, water, and a minimum of 1,150 pounds of cement per cubic yard formulated for a minimum 28-day compressive strength of 5,000 psi.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Section 01 10 00 –Summary of Work.

B. Verify requirements for concrete cover over reinforcement.

C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

C. Slurry Mix at Horizontal Construction Joints

1. Unless otherwise specifically directed, in all horizontal construction joints in new concrete construction containing water-stops, provide an initial layer of slurry mix to aid in consolidation of freshly placed concrete at the joint interface.
2. Place slurry mix 2-inch minimum to 4-inch maximum in thickness.

3. Place with buckets or other means permitting visual verification that only enough slurry mix is deposited in the vicinity of the concrete pour to meet the thickness requirements.

4. Place concrete over slurry mix while slurry mix is still flow-able.

5. Limit initial concrete placement on top of slurry mix to 12-inches in thickness. Thoroughly vibrate and consolidate the concrete and slurry mix.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 318 and ACI 350.

B. Notify Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, water-stops, formed expansion and contraction joints, and are not disturbed during concrete placement.

D. Install joint fillers, primers, and sealant in accordance with the manufacturer's instructions.

E. Separate slabs on grade from vertical surfaces with ½-inch thick joint filler.

F. Extend joint filler from bottom of slab to within ¼ inch of finished slab surface.

G. Install joint devices in accordance with manufacturer's instructions.

H. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor and wall finish.

I. Install joint covers in one piece, longest practical length, when adjacent construction activity is complete.

J. Apply sealants in joint devices in accordance with manufacturer's recommendations.

K. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

L. Place concrete continuously between predetermined control and construction joints.

M. Do not interrupt successive placement; do not permit cold joints to occur.

3.4 CONCRETE FINISHING

A. Provide formed and un-formed concrete surfaces with finishes as Scheduled. See General Structural Notes Sheet S-002 Sections 15 and 16.

B. Finish concrete slab surfaces in accordance with ACI 302, and Section 03 35 00 – Concrete Finishing.

C. In areas required to drain pitch surface uniformly to drain as indicated on drawings.

D. In areas identified for coatings, provide Surface Finish required, and Coatings per Technical Specifications Division 9 and the Architectural Finish Schedule.

E. All concrete surfaces shall receive a Surface Finish; where question arise as to finish type, contact the Project Engineer for clarification.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for the period necessary for hydration of cement and hardening of concrete.

C. Unless otherwise approved, concrete shall be maintained above 50°F and in a moist condition for a minimum of seven days after placement.

D. Cure concrete surfaces in accordance with ACI 308.

3.6 FIELD QUALITY CONTROL

A. Field review and testing will be performed in accordance with ACI 301 and under provisions of Section 01 40 00.

B. All concrete repair or restoration shall comply with the provisions of 3.8 Defective Concrete of this Section.

C. Provide free access to Work and cooperate with appointed firm.

D. Submit proposed mix design of each class of concrete to Engineer and testing firm for review prior to commencement of Work.

E. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

F. One additional test cylinder may be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.7 PATCHING

A. Allow Engineer to review concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections as directed by the Engineer and in accordance with ACI 301.

D. Patch cone holes at form ties to match adjacent concrete.

E. Reference Section 03 01 00 – Maintenance of Concrete.

3.8 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

B. During the progress of the work, if the laboratory-cured values shown for each concrete design strength and quality as determined by compression cylinders fail to attain the requirements specified, suspend all concrete work. Concrete that has been placed in the work and does not meet the specified requirements will be reviewed by the Engineer and the Contractor. Any field testing such as core drilling required to verify in-place concrete strengths after compression tests fail to meet requirements shall be at the Contractor's expense. The Contractor shall, at his own expense, correct or remove the defective work in a manner approved by the Engineer.

C. The following criteria shall be followed in defining cracks by minimum measured crack width, using feeler gauges or other approved means:

1. Cracks with maximum widths less than 0.015 inches (1/64 inch) shall be considered hair-line cracks and shall be repaired or sealed as directed by the Project Engineer.
2. Cracks equal to or greater than 0.015 inches (1/64 inch) and less than or equal to .095 inches (3/32 inch) in width at any point shall be considered medium cracks with mandatory repair by injection required.
3. Any cracks equal to or greater than 0.095 inches (3/32 inch) in width at any point shall be considered large cracks with mandatory repair by injection or as directed by the Project Engineer.

D. Repair or replacement of defective concrete will be determined by the Engineer.

E. Repair defects in formed concrete surfaces within 24 hours of removing forms.

F. Replace defective concrete within 48 hours.

G. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

H. Cut out and remove defective area.

I. Cut edges square to avoid feathering.

J. Comply with ACI 301, Chapter 9.

K. Perform repair work so as not to interfere with curing of adjacent concrete.

L. Adequately cure repair work.

M. Reference Section 03 01 00 – Maintenance of Concrete.

END OF SECTION

SECTION 03 35 00
CONCRETE FINISHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittals
2. Closeout Submittals
3. Quality Assurance
4. Qualifications
5. Delivery, Storage and Handling
6. Environmental Requirements
7. Coordination
8. Examination
9. Floor Finishing
10. Floor Surface Treatment
11. Other Concrete Surfaces
12. Tolerances

B. Related Sections:

1. Section 01 20 00 – Measurement and Payment
2. Section 03 30 00 – Cast-In-Place Concrete
3. Section 03 39 00 – Concrete Curing
4. Section 07 92 13 – Sealants and Caulking

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.

B. ASTM International (ASTM):

1. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.

C. California Department of Health Services (CA DHS):

1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

D. South Coast Air Quality Management District (SCAQMD):

1. SCAQMD Rule 1113 - Architectural Coatings.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal Procedures.

B. Product Data: Submit data on concrete hardener, sealer, curing compounds, curing papers and slip resistant treatment, compatibilities, and limitations.

C. Technical Data Sheets: For concrete hardener system, Contractor shall submit a technical data sheet from the manufacturer. The technical data sheet shall, at a minimum, provide the material name, manufacturer name, product name and number, material specification, recommended coverage, and thickness.

D. Material Safety Data Sheets (MSDS).

E. Copy of warranty to be issued.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 –Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 302.1.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator or Installer: Company specializing in performing work of this section with minimum three years documented experience with the product or manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Transportation and Handling

B. Deliver materials in manufacturer's packaging including application instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – Product Requirements: Storage and Protection

B. Temporary Heat: Ambient temperature of 50°F minimum.

C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.9 COORDINATION

A. Section 01 33 00 – Submittal Procedures

B. Coordinate the Work with concrete floor placement and concrete floor curing.

PART 2 PRODUCTS

2.1 COMPOUNDS - HARDENERS AND SEALERS

A. Chemical Sealer and Hardener: Transparent chemically reactive water-based sealer/hardener.

1. Manufacturers:

   a. Ashford Formula.

   b. Sonneborn Building Products, Product Kure-N-Seal

   c. Dayton Superior, Product Safe Cure & Seal

   d. ChemMasters, Product Cure & Seal.

   e. Tennant Company, Product Eco-Hard-N-Seal.

2. Note: contractor to coordinate, verify and provide concrete hardener which is rated for exterior use when applied in exterior locations.

3. Concrete hardener is to be applied to all interior and exterior concrete floor slabs receiving foot traffic or other maintenance work. Hardener is not required inside water-retaining structures or on floors to receive architectural coverings such as tile, carpet, or vinyl flooring.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 33 00 – Submittal Procedures

B. Verify floor surfaces are acceptable to receive the Work of this section.

3.2 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1. See General Structural Notes Sheet S-002 Section 16.

B. Wood float surfaces receiving quarry tile, ceramic tile or cementitious terrazzo with full bed setting system.

C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set terrazzo, thin set quarry tile or thin set ceramic tile.

D. Steel trowel surfaces which are indicated to be exposed.

E. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains at 1/8 inch per foot nominal or as indicated on Drawings.

3.3 FLOOR SURFACE TREATMENT

A. Apply Chemical Sealer and Hardener on all interior and exterior concrete work surfaces. Contractor to verify/provide product suitable for exterior applications.

3.4 OTHER CONCRETE SURFACES

A. See General Structural Notes Sheet S-002 Section 15.

3.5 TOLERANCES

A. Section 01 40 00 – Quality Assurance and Quality Control: Tolerances

B. Maximum Variation of Surface Flatness for Exposed Concrete Floors: 1/4 inch in 10 feet for office area floors.

C. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

END OF SECTION

SECTION 03 39 00
CONCRETE CURING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes initial and final curing of all horizontal and vertical concrete surfaces.

B. Related Sections:

1. Division 01
2. Division 03

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 301 - Specifications for Structural Concrete
2. ACI 302.1 - Guide for Concrete Floor and Slab Construction
3. ACI 308.1 - Standard Specification for Curing Concrete
4. ACI 318 - Building Code Requirements for Structural Concrete
5. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures

B. ASTM International (ASTM):

1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures

B. Product Data: Submit data on curing compounds, mats, film, compatibilities, and limitations.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 308.

B. Maintain one copy of each document on site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Division 1: Product storage and handling requirements.

B. Deliver curing materials in manufacturer's packaging including application instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Membrane Curing Compound: ASTM C1315 Type I, Class A.

B. Absorptive Mats Type C: ASTM C171, cotton fabric, burlap-polyethylene, minimum 8 oz/sq yd bonded to prevent separation during handling and placing.

C. Polyethylene Film Type E: ASTM C171, six mil thick clear, white, or black. Color use may depend on daily ambient temperatures per ACI 308.1 requirements.

D. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 1: Coordination and Project Conditions

B. Verify substrate surfaces are ready to be cured.

3.2 INSTALLATION - HORIZONTAL SURFACES

A. Cure concrete in accordance with ACI 308.1 with one of the following methods.

B. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 5 days minimum.

C. Fog Spraying: Spray water using fog-spray equipment over floor slab areas and maintain wet for 7 days minimum. Direct discharge of the atomized water spray onto the surface of the concrete is unacceptable.

D. Absorptive Mat: Spread cotton fabric over floor slab areas. Spray with water until mats are saturated and maintain in saturated condition for 7 days minimum.

E. Membrane Curing Compound: Apply curing compound in two coats with second coat applied at right angles to first.

3.3 INSTALLATION - VERTICAL SURFACES

A. Cure concrete in accordance with ACI 308.1.

B. Fog Spraying: Spray water using fog-spray equipment over floor slab areas and maintain wet for seven days minimum. Direct discharge of the atomized water spray onto the surface of the concrete is unacceptable.

C. Membrane Curing Compound: Apply compound in two coats with second coat applied at right angles to first.

3.4 SURFACES INSIDE FORMWORK

A. Concrete surfaces protected by formwork require no special curing treatment as long as the formwork remains in place a minimum of seven days or until the concrete has reached the specified strength.

B. If forms are removed prior to seven days or the concrete attaining the specified strength, then all surfaces shall be cured as specified elsewhere in this Section for the remainder of the required curing period.

C. Top or other exposed portions of walls and other concrete elements covered with protecting formwork require curing as specified elsewhere in this Section.

D. In hot weather wall forms shall be hosed down with water and covered with protective polyethylene Film to prevent excessive moisture loss.

3.5 PROTECTION OF FINISHED WORK

A. Section 01 70 00 – Closeout Requirements: Protecting finished Work

B. Do not permit traffic over unprotected floor surface.

3.6 SCHEDULES

A. Liquid Retaining Structure Walls: In-form curing, fog spraying or membrane curing compound.

B. Liquid Retaining Structure Floor Slabs-on-grade: Ponding, moist absorptive mats, or membrane curing.

C. Building foundation walls and retaining walls: In-form curing, fog spraying or membrane curing compound.

D. Non-liquid Retaining Structure Floor Slabs-on-grade: Moist absorptive mats, or membrane curing.

E. All other concrete: In-form curing, moist absorptive mats, fog spraying, or membrane curing compound.

END OF SECTION

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SECTION 03 41 00
TESTING CONCRETE STRUCTURES FOR WATERTIGHTNESS

PART 1 GENERAL

1.1 SUMMARY

A. Watertightness testing requirements for manholes, process tanks, distribution boxes, channels, and similar structures that contain water (continuously or intermittently).

1.2 RELATED SECTIONS

A. Division 01

1.3 REFERENCES

A. American Concrete Institute (ACI) 350R – Environmental Engineering Concrete Structures

B. ACI 350.1 R – Testing Reinforced Concrete Structures for Watertightness

1.4 QUALITY ASSURANCE

A. Testing: Provide watertightness testing for all water-containment structures in accordance with ACI 350.1R.

B. Hydrostatic Test (HST) for open or covered tanks.

1. HST-100: The maximum overall percent loss water volume shall be 0.100 percent per day of the test. The test shall be continued for a duration sufficient to cause a 3/8-inch (10 mm) drop in the water surface assuming the loss of water is at the maximum rate.

2. HST-VIO: The Hydrostatic Visual Inspection Test (HST-VIO) has no numerical value for the allowable loss of water during the tightness test. However, no flow or seepage of water from the tank shall be present on the exterior surfaces for 24 hours after the tank is filled. For purposes of this test, seepage shall be defined as spots where moisture can be picked up on a dry hand or tissue.

C. Perform a watertightness test as required by the Engineer on any additional structure when in the opinion of the Engineer the structure contains sufficient concrete defects that could impair the watertightness of the structure.

1. Testing to conform to requirements of this specification section with allowable leakage and other criteria as established by Engineer.

2. Pay for all labor and material costs resulting from this testing.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Submit detailed plan for testing, including testing of subbasins of structures, necessary temporary bulkheads and components, personnel responsible for conducting the testing, personnel responsible for analyzing the results, testing and monitoring equipment, etc.

C. Submit to Engineer results of watertightness testing indicating the following:

1. Level of water in structure and evaporation pan at commencement and duration of final test period.

2. Level of water in structure and evaporation pan at end of final test period.

3. Tabular results of leakage testing, including water depth change, water and air temperature, precipitation, evaporation, total loss, and loss due to leak.

4. Net leakage in percent of total volume during final test period (gross leakage minus that due to evaporation).

5. Area, methods, and materials of patching to correct leakage.

6. Results of retesting if required due to leakage exceeding allowed values.

D. Testing for watertightness, with accompanying results, to be witnessed by Engineer.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 CONCRETE STRUCTURES REQUIRING TESTING

A. The following is a minimum list of concrete structures which shall be tested. The Engineer may require watertightness testing of any other structure at any time.

1. Yard Piping Manholes

2. Solids Holding Tank

3.2 PREPARATION BEFORE TESTING

A. Testing shall be performed prior to application of coatings, prior to placement of exterior backfill soil, and prior to placement of exterior concrete masonry.

B. Notify the Engineer in at least 24 hours prior to the filling of any structure for leakage testing.

C. Testing shall be performed per the Contract Documents and as recommended by ACI 350.1 R.

D. Cleaning: Thoroughly clean interior of structure to be tested of all debris and dirt and hose down surfaces of all walls and slabs.

E. Patching shall be per Section 03 30 00 and as follows:

1. Completely fill tie holes.

2. Fill voids and honeycombed areas with patching grout.

3. Cracks suspected to cause leakage shall be filled with epoxy adhesive.

4. Patching to be performed after concrete defective area is cleaned of all loose material to surface of sound concrete.

5. Finish wall surfaces per the General Concrete Notes and Specifications on the project drawings.

3.3 TESTING FOR LEAKAGE

A. The exterior of each basin shall be tested according to HST-100 and HST-VIO as defined in this section.

B. The interior walls of each basin shall be independently tested according to HST-100 as defined in this section.

C. The purpose of this test is to determine the integrity of the finished concrete and to show that the exposed wall surfaces are visually acceptable. Therefore, all other equipment (i.e., stop gates, sluice gates, valves, etc.) and temporary bulkheads shall be made watertight prior to the test and shall be monitored before and during the test to determine the watertightness of these appurtenances. Leakage at these outlets shall be repaired prior to test measurements. No allowance shall be made in test measurements for uncorrected known points of leakage. The flow from the underdrain system (if any) shall be monitored during this same period and any increases in flow shall be recorded.

D. If the tank is to be filled using the tank inlet pipe, positive means shall be provided to check that water is not entering or leaving the tank through this pipe once the tank is filled to test level.

E. The ground water level shall be maintained at a level below the top of the base slab and kept at that elevation (or lower) during the test.

F. All water-containment structures shall be subjected to leakage tests after the concrete has been cured and obtained its design strength and before backfilling or other work that will cover the concrete surfaces of the walls has begun. The minimum curing period for all concrete comprising the foundations, floor slabs, walls, and columns shall be the

time required for all concrete to reach the minimum specified compressive strengths as verified by concrete cylinder compression tests, but no less than 28-days.

G. Water Source

1. Potable water required for the testing shall be provided by the Contractor. If plant effluent is utilized, the effluent shall be following disinfection and subsequently chlorinated with an initial chlorine residual of 2 ppm minimum.

2. Contractor shall provide the necessary pump(s) and conveyance systems to fill and drain the structures, as necessary.

3. Upon completion of the testing, the water shall be disposed of back into the treatment system at the Headworks or accordance with the plant supervisor's instructions. Dispose of water such that new or existing construction is protected and to avoid overloading, interfering, or otherwise impacting plant operations. If disinfected plant effluent is used for testing, washdown surfaces and clean / disinfect as necessary to avoid putrescent odors.

H. Initial Filling

1. All water-containment structures shall be filled with potable water or disinfected and chlorinated plant effluent to one foot below top of wall (unless noted otherwise) prior to leak testing except for manholes, which shall be filled to the top of the cone prior to leak testing.

2. After these structures have been kept full for 72 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the basin is complete.

3. Contractor shall refill to the starting water level for initiation of the testing.

I. Initiation of Testing

1. The change in water surface shall be measured for a 24-hour period.

2. During the test period all exposed portions of the structure shall be examined for dampness or leaks, and all visible leaks or damp spots shall be marked; such leaks or damp spots shall later be patched or corrected in a manner acceptable to the Engineer prior to additional leakage testing.

3. If the drop in water surface in the 24-hour period exceeds one gallon per thousand gallons of volume of liquid contained in the water-holding structure, after accounting for evaporation and precipitation in open basins, or if damp spots or any seepage is present on the walls or other areas exposed to view, the leakage shall be considered excessive, and the leakage test will be considered to have failed.

4. Evaporation shall be determined by floating an evaporation pan in the structure during the test period.

5. If the leakage is determined to be excessive (as defined above) or if damp spots and observed seepage are present on exposed surfaces, the water-containment structure shall be drained for repair. Cracks shall be sealed in accordance with Section 03 30 00 – Cast-in-place Concrete. Any leakage or seepage through the joints shall be repaired to the satisfaction of the Engineer. Contractor shall submit a proposed method of repair for all cracks, areas of leakage, and areas of seepage for review and approval by Engineer.

6. The water-containment structure shall then be refilled to the levels noted previously and tested again for leakage. Contractor shall repeat the testing and repair process as many times as necessary until the leakage test passes.

7. All repairs of faulty workmanship and materials, and additional tests, shall be made by the Contractor in an acceptable manner, at no additional cost to the Owner. Both the correction for excessive leakage and the removal of the damp or wet spots on walls shall be required to pass the leakage test.

J. All costs for testing the water-containment structures, including re-testing and all associated repairs, shall be borne by the Contractor.

END OF SECTION

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SECTION 03 60 00
GROUTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Portland Cement Grout
2. Non-Shrink Cementitious Grout

B. Related Sections:

1. Section 01 20 00 – Measurement and Payment
2. Section 05 12 00 – Structural Steel

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 301 - Specifications for Structural Concrete
2. ACI 318 - Building Code Requirements for Structural Concrete

B. ASTM International (ASTM):

1. ASTM C33 - Standard Specification for Concrete Aggregates
2. ASTM C40 - Test Method for Organic Impurities in Fine Aggregates for Concrete
3. ASTM C150 - Standard Specification for Portland Cement
4. ASTM C191 - Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
5. ASTM C307 - Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacings and Polymer Concretes
8. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

1.3 SUBMITTALS

A. Product Data: Submit product data on grout.

B. Manufacturer's Installation Instructions: Submit manufacturer’s instructions for mixing, handling, surface preparation and placing epoxy type and non-shrink type grouts.

C. Proposed flowable fill mix design report.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver grout in manufacturer's unopened containers with proper labels intact.

B. Store grout in a dry shelter, protect from moisture.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT GROUT MATERIALS

A. Portland Cement: ASTM C150, Type II

B. Water:

1. Potable; containing no impurities, suspended particles, algae or dissolved natural salts in quantities capable of causing:
    a. Corrosion of steel
    b. Volume change increasing shrinkage cracking
    c. Efflorescence
    d. Excess air entraining

C. Fine Aggregate:

1. Washed natural sand
2. Gradation in accordance with ASTM C33 and represented by smooth granulometric curve within required limits.
3. Free from injurious amounts of organic impurities as determined by ASTM C40.

D. Mix:

1. Portland cement, sand and water. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 NON-SHRINK CEMENTITIOUS GROUT

A. Non-shrink Cementitious Grout: Pre-mixed ready for use formulation requiring only addition of water; non-shrink, non-corrosive, non-metallic, non-gas forming, no chlorides.

B. Properties: Certified to maintain initial placement volume or expand after set and meet the following minimum properties when tested in accordance with CRD-C621, for Type D non-shrink grout:

Property	Test	Time	Result
Setting Time	ASTM C191	Initial	2 hours (Approx)
		Final	3 hours (Approx)
Expansion			0.10% - 0.4% Maximum
Compressive Strength	CRD-C621	1 day	4,000 psi
		7 days	7,000 psi
		28 days	10,000 psi to 10,800 psi

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify areas to receive grout.

3.2 PREPARATION

A. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.

B. Rough concrete lightly, but not enough to interfere with placement of grout.

C. Remove foreign materials from metal surfaces in contact with grout.

D. Align, level, and maintain final positioning of components to be grouted.

E. Saturate concrete surfaces with clean water; remove excess water, leave none standing.

3.3 INSTALLATION - FORMWORK

A. Construct leak-proof forms anchored and shored to withstand grout pressures.

B. Install formwork with clearances to permit proper placement of grout.

3.4 MIXING

A. Portland Cement Grout:

1. Use proportions of two parts sand and one part cement, measured by volume.

2. Prepare grout with water to obtain consistency to permit placing and packing.

3. Mix water and grout in two steps; pre-mix using approximately 2/3 of water; after partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.

4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.

5. Do not add additional water after grout has been mixed.

6. Capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

B. Mix grout components in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials.

3.5 PLACING GROUT

A. Place grout material quickly and continuously.

B. Do not use pneumatic-pressure or dry-packing methods.

C. Apply grout from one side only to avoid entrapping air.

D. Do not vibrate placed grout mixture, or permit placement when area is being vibrated by nearby equipment.

E. Thoroughly compact final installation and eliminate air pockets.

F. Do not remove leveling shims for at least 48 hours after grout has been placed.

3.6 CURING

A. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. After grout has attained its initial set, keep damp for minimum of three days.

3.7 FIELD QUALITY CONTROL

A. Submit proposed mix design of each class of grout to inspection and testing firm for review prior to commencement of work.

B. Tests of grout components may be performed to ensure conformance with specified requirements.

END OF SECTION

SECTION 04 01 00
MAINTENANCE OF MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section includes water, steam, and chemical cleaning of masonry surfaces; replacement of masonry units; sand blast cleaning of masonry surfaces; repointing mortar joints; and repair of damaged masonry.

B. Related Sections:

1. Division 1

2. Division 3

3. Division 4

1.2 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 530 - Building Code Requirements for Masonry Structures.

2. ACI 530.1 - Specifications for Masonry Structures.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures

B. Product Data: Submit data on cleaning compounds and cleaning solutions.

C. Manufacturer's Installation Instructions: Submit installation procedures for products selected for use, manufacturer's installation instructions, perimeter conditions requiring special attention.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 530 and ACI 530.1 requirements.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Division 1: Product storage and handling requirements.

B. Deliver masonry neatly stacked and tied on pallets. Store clear of ground with adequate waterproof covering.

C. Store sand blasting, acid solution and restoration cleaner materials in manufacturer's packaging.

D. Store mortar ingredients in manufacturer's packaging, or when delivered loose, with adequate weatherproof covering.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Division 1.

B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40°F.

C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100°F or ambient temperature is greater than 90°F with wind velocity greater than eight miles per hour (mph).

PART 2 PRODUCTS

2.1 COMPONENTS

A. Cleaning Agent: Detergent, solvent cleaner, or acid solution.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 1: Coordination and project conditions.

B. Verify surfaces to be cleaned or restored are ready for work of this section.

3.2 PREPARATION

A. Protect elements surrounding work of this section from damage or disfiguration.

B. Immediately remove stains, efflorescence, or other excess resulting from work of this section.

C. Protect roof membrane and flashings from damage.

D. Provide dams to divert flowing water to exterior drains.

E. Carefully remove and store fixtures, fittings, finishing hardware and accessories.

F. Close off, seal, mask, and/or board up areas, landscaping, materials, and surfaces not receiving work of this section to protect from damage.

G. Construct dust proof and weatherproof partitions to close off occupied areas.

3.3 INSTALLATION

A. Cleaning New Masonry:

1. Verify mortar is fully set and cured.

2. Clean surfaces and remove large particles with wood scrapers, brass, or nylon wire brushes.

3. Scrub walls with detergent solution using stiff brush. Thoroughly rinse and wash off cleaning solution, dirt and mortar crumbs using clean, pressurized water.

4. Use acid solution mixed with water. Apply acid solution and scrub masonry with stiff fiber brushes. Do not scrub mortar joints.

5. Protect area below cleaning operation and keep masonry soaked with water and flushed free of acid and dissolved mortar continuously for duration of cleaning.

6. Before solution dries, rinse and remove acid solution and dissolved mortar, using clean, pressurized water.

3.4 CLEANING

A. Section 01 70 00 – Closeout Requirements: Final cleaning.

B. As work proceeds and on completion, remove excess mortar, smears, droppings.

C. Clean surrounding surfaces.

END OF SECTION

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SECTION 04 10 00
MORTAR AND GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortar and grout for masonry.

1.2 SUBMITTALS

A. Samples: Submit two samples of mortar illustrating mortar color and color range to Engineer and Architect per Section 01 33 00.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with American Concrete Institute (ACI) 530 and ACI 530.1.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Hot Weather Requirements: International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

B. Cold Weather Requirements: IMIAC – Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement: ASTM International (ASTM) C150, Type I, gray color

B. Mortar Aggregate: ASTM C144, standard masonry type

C. Hydrated Lime: ASTM C207, Type S

D. Mortar Color: Mineral oxide pigment; color as selected

E. Grout Aggregate: ASTM C404

F. Water: Clean and potable

G. Bonding Agent: Epoxy type

2.2 MORTAR MIXES

A. Mortar for Load Bearing Walls and Partitions: ASTM C270, Type S using the Property Method.

B. Mortar for Reinforced Masonry: ASTM C270, Type S using the Property Method.

C. Stain Resistant Pointing Mortar: One part Portland cement, 1/8-part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate or ammonium stearate equal to two percent of Portland cement by weight.

D. Integral Water-Repellent Mortar Admixture:

1. Integral liquid polymeric admixture for mortar added during mixing. Dry-Block Mortar Admixture manufactured by Grace Construction Products. Subject to compliance with requirements, equivalent products by the following manufacturers are acceptable.

a. ACM Chemistries, Inc.: Rain Bloc for Mortar

b. BASF: Rheopel Mortar Admixture

c. Approved equal

2.3 MORTAR MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.

B. Add mortar color and admixtures in accordance with manufacturer's instructions.

C. Do not use anti-freeze compounds to lower the freezing point of mortar.

2.4 GROUT MIXES

A. Bond Beams, Lintels and Engineered Masonry: 2,000 psi strength at 28 days; 8”-11” slump; mixed in accordance with ASTM C476 Fine Grout

2.5 GROUT MIXING

A. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C476 Fine grout.

B. Do not use anti-freeze compounds to lower the freezing point of grout.

2.6 MIX TESTS

A. Test mortar and grout in accordance with Section 01 40 00 and the General Structural Notes in the Plans.

B. Testing of Mortar Mix: In accordance with ASTM C780.

C. Testing of Grout Mix: In accordance with ASTM C1019.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install mortar in accordance with ASTM C780. Install grout in accordance with ASTM C1019.

B. Work grout into masonry cores and cavities to eliminate voids. Do not displace reinforcement.

END OF SECTION

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SECTION 04 30 00
REINFORCED UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete Masonry Units (CMUs).

B. Related Requirements:

1. Division 1
2. Division 3
3. Division 4
4. Division 5
5. Division 6
6. Division 7
7. Division 8
8. Division 9
9. Division 10

1.2 REFERENCE STANDARDS

A. American Concrete Institute (ACI):

1. ACI 530 - Building Code Requirements for Masonry Structures.
2. ACI 530.1 - Specification for Masonry Structures.

B. ASTM International (ASTM):

1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 pounds per square inch (psi) Tensile Strength.

4. ASTM A580 - Standard Specification for Stainless Steel Wire.

5. ASTM A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.

6. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

7. ASTM A951 - Standard Specification for Steel Wire for Masonry Joint Reinforcement.

8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.

9. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

10. ASTM C27 - Standard Classification of Fireclay and High Alumina Refractory Brick.

11. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.

12. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

13. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

14. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

15. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.3 COORDINATION

A. Division 2: Requirements for coordination.

B. Coordinate Work of this Section with installation of window and door anchors.

C. Direct and coordinate placement of metal anchors supplied to other Sections.

D. Coordinate Work of this Section with installation of emergency key cabinets.

1.4 PREINSTALLATION MEETINGS

A. Division 2: Requirements for pre-installation meeting.

1.5 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit data for masonry units, fabricated wire reinforcement, anchors, and other accessories.

C. Shop Drawings:

1. Indicate bar sizes, spacing, laps, locations, reinforcement quantities, bending and cutting schedules, supporting, and spacing devices for reinforcement, and accessories.

2. Describe geometry of the masonry structure(s), location of any vertical or horizontal construction and/or control joints, penetrations, block-outs, anchor bolts, embedded electrical and instrumentation conduits and other embedded items.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Samples: For initial verification submit the following:

1. Unit masonry samples in small-scale form showing colors and textures for each different exposed masonry unit indicated.

2. Colored mortar samples showing full extend of colors available.

3. Provide full size block samples of matching shape, size, and color

F. Data Sheet:

1. Integral CMU and Mortar Water-Repellent Admixture.

a. Test Reports prepared by a qualified independent laboratory indicating compliance with the performance requirements for integral water-repellency as tested using:

i. ASTM E 514, Extended to 72 hours.

ii. ASTM C 1357

iii. ASTM C 1314

iv. ASTM C 1148

1.6 QUALITY ASSURANCE

A. Structural Tests and Special Inspections: Conform to International Building Code (IBC) Chapter 17 and IBC Chapter 21 for special inspections and quality assurance verification testing of compressive strength of each unit masonry wythe using prism test method as tested to ASTM C1314.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Division 1: Requirements for transporting, handling, storing, and protecting products.

1.8 AMBIENT CONDITIONS

A. Division 1: Requirements for ambient condition control facilities for product storage and installation.

B. Cold Weather Requirements: Conform to ACI 530.1 when ambient temperature or temperature of masonry units is less than 40˚F.

C. Hot Weather Requirements: Conform to ACI 530.1 when ambient temperature is greater than 100˚F, or ambient temperature is greater than 90˚F with wind velocity greater than eight miles per hour.

PART 2 PRODUCTS

2.1 REINFORCED UNIT MASONRY ASSEMBLIES

A. Concrete Unit Masonry Compressive Strength (f'm): Minimum 2,000 psi minimum net area compressive strength as determined by prism test method.

2.2 MATERIALS

A. Hollow Load-Bearing Concrete Masonry Units (CMU): ASTM C90; medium weight.

B. Concrete Masonry Unit Size and Shape: Furnish special units for 90-degree corners, bond beams, bases, lintels, and fillers to match and complement block units. Nominal modular sizes:

1. 8 inches by 8 inches by 16 inches nominal.

2. 12 inches by 8 inches by 16 inches nominal.

C. Style: Color and textures and indicated in the Architectural drawings. Interior walls are to be smooth face units.

D. Color: Exterior CMU walls to be colored block. Interior CMU walls can be natural grey if painted, if clear sealer is specified, the interior CMU block color is to match the exterior walls. Refer to Architectural drawings and Section 09 91 00 for coating requirements.

E. Integral CMU Water-Repellent:

1. Integral liquid polymeric admixture mixed with the concrete during production of CMUs. Dry-Block Block Admixture manufactured by Grace Construction Products. Subject to compliance with requirements, equivalent products by the following manufacturers are acceptable.

   a. ACM Chemistries, Inc.: Rain Bloc.

   b. BASF: Rheopel Plus.

   c. Approved Equal.

2. Water Permeance of Masonry: Capable of achieving a Class E Rating when evaluated using ASTM E 514 with the test extended to 72 hours, using the rating criteria specified in ASTM E 514-74.

3. Bond strength as determined by ASTM E 72 shall not be reduced using water repellent admixture.

F. Painting: CMU is to be painted in accordance with Division 9 of this specification, and the drawings. See room finish schedule in the drawings.

2.3 ACCESSORIES

A. Reinforcing Steel: Deformed type, as specified in Section 03 20 00 - Concrete Reinforcement, uncoated finish.

B. Reinforcing Bar Positioners: Cold-drawn steel wire, 11 gage, ASTM A153, hot-dip galvanized ASTM A580, designed to prevent displacement of reinforcing steel and maintain adequate grout coverage within unit masonry cells.

1. Vertical Bar: Fabricate for positioning each vertical bar lap splice.

2. Horizontal Bar Positioners: Fabricate for positioning bar at top of bond beam.

C. Anchor Rods: ASTM A307, Grade A (60 yield strength); J-shaped or L-shaped; complete with washers and heavy hex nuts; sized for minimum 15-in embedment or as specified on drawings; galvanized finish.

1. Hot-Dip Galvanizing: ASTM A153.

2. Mechanical Galvanizing: ASTM B695; Class 55.

D. Mortar and Grout: As specified in Section 04 10 00 – Mortar and Grout.

E. Masonry Control Joint, Expansion Joint, and Relief Angle Sealant: Double weather seal, as specified Section 07 92 00 – Joint Sealants – Architectural.

1. Exposed Joint Sealers: As specified in Division 7.

2. Back-up Sealant: As Specified in Division 7.

F. Control Joints:

1. Standard Preformed Control Joints: Molded Rubber, Neoprene or Polyvinylchloride material; Durometer hardness 70 + 5 nominal, 3/8-inch thick. Furnish with corner and tee accessories; heat cement-fused joints.

2. 3-Hour Fire Rated Control Joints: Reference notes and plans identified in Architectural Details on the Architectural Drawings.

G. Cleaning Solution: Commercial masonry cleaner that is not harmful to masonry or adjacent materials. Conform to manufacturer instructions. Muriatic acid and other acidic solutions not permitted.

H. Through-Wall Flashing.

1. Material

a. Galvanized sheet steel of at least 20 gauge.

2.4 SOURCE QUALITY CONTROL

A. Division 1: Requirements for testing, inspection, and analysis requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 1: Requirements for installation examination.

B. Verify field conditions are acceptable and are ready to receive Work prior to beginning.

C. Verify items provided by other Sections of Work are properly sized and located.

D. Verify built-in items are in proper location and ready for roughing into masonry work.

E. Verify masonry units free of cracks, spalling, disfigurements, face chips, or edge chips more than 1/4 inch in length or depth. Clean free of bond breakers and other foreign substances.

3.2 PREPARATION

A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for installation preparation.

3.3 INSTALLATION

A. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

B. Establish lines, levels, and coursing indicated. Protect from displacement.

C. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

D. Align exposed exterior faces of masonry flush, allowing block thickness variations to appear on unexposed or interior face.

E. Coursing of Concrete Masonry Units:

1. Bond: Running.

2. Coursing: One unit and one mortar joint to equal eight inches.

3. Mortar Joints: Concave.

F. Placing and Bonding:

1. Lay hollow masonry units with face shell bedding on head and bed joints.

2. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

3. Remove excess mortar as Work progresses.

4. Interlock intersections and external corners.

5. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar, and replace.

6. Perform jobsite cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

G. Lintels:

1. Install reinforced unit masonry lintels as indicated on the Drawings over openings where steel or precast concrete lintels are not scheduled or indicated.

2. Do not splice longitudinal reinforcing bars over openings.

3. Support and secure reinforcing bars from displacement.

4. Place and consolidate grout fill without displacing reinforcing.

5. Allow masonry lintels to attain specified strength before removing temporary supports.

6. Maintain minimum 8-inch minimum bearing on each side of opening

7. Grout lintels solid to a minimum depth of 16-inches or two courses of block. Grout solid to a greater depth where indicated on the drawings.

8. Standard open core blocks cannot be used as lintel blocks.

H. Grouted Components:

1. Reinforce bond beam with as indicated on the drawings.

2. Lap splices' bar diameters as required by code or indicated on the drawings.

3. Support and secure reinforcing bars from displacement.

4. Place and consolidate grout fill without displacing reinforcing.

5. At bearing locations, fill masonry cores with grout for a minimum of 12 inches either side of opening.

I. Reinforced Masonry:

1. Lay masonry units with cells vertically aligned and clear of mortar and unobstructed.

2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.

3. Splice reinforcement as indicated on the Drawings.

4. Support and secure reinforcement from displacement.

5. Place and consolidate grout fill without displacing reinforcing.

6. Place grout according to ACI 530.1

J. Control and Expansion Joints:

1. Install control and expansion joints as indicated on Drawings:

2. Do not continue horizontal joint reinforcement through control and expansion joints except as noted on the Drawings.

3. Install preformed control joint device in continuous lengths. Seal butt and corner joints.

4. Size control joint according to Section 07 92 00 – Joint Sealants – Architectural for sealant performance.

K. Built-in Work:

1. As Work progresses, install built-in metal door frames, fabricated metal frames, window frames, anchor bolts, plates, and other items to be built in the Work and furnished by other Sections.

2. Install built-in items plumb and level.

3. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum eight inches from framed openings.

4. Do not build in materials subject to deterioration.

L. Cutting and Fitting:

1. Cut and fit for chases, pipes, conduit, sleeves, grounds, and other items required. Coordinate with other Sections of Work to provide correct size, shape, and location.

2. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

M. Cleanouts at Solid-Grouted, Hollow-Core Masonry:

1. Locate at bottom course of each grout lift at each vertical reinforcing bar with maximum 32 inches o.c. at solid grouted walls for grout pours exceeding five feet in height, according to ACI 530.1.

2. Make cleanout by removing and reinstalling entire face of masonry unit at exterior wall surfaces.

3. Clean grout space prior to grouting to remove mortar droppings, mortar projections larger than 1/2 inch, and other foreign matter.

4. Seal cleanouts after inspection and before grouting.

N. Repairs and Infill in Existing Masonry

1. Provide matching block and mortar (no water repellent admixture). Apply CMU water repellent per Division 9.

2. Submit shop drawings and samples for masonry units to match existing structures.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 – Quality Requirements: Requirements for tolerances.

B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.

D. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in three feet and 1/4 inch in 10 feet; ½ inch in 30 feet.

F. Maximum Variation of Joint Thickness: 1/8 inch in three feet.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

H. Maximum Variation for Steel Reinforcement:

1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.

2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is eight inches or less.

3. Plus or minus one inch when distance is between eight and 24 inches.

4. Plus or minus 1-1/4 inch when distance is greater than 24 inches.

5. Plus or minus two inches from location along face of wall.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Requirements specifies requirements for inspecting and testing.

B. Test each type of concrete masonry units according to ASTM C140.

C. Cut out damaged and defective work, reconstruct with new masonry materials, and repoint with mortar.

D. Remove excess mortar on masonry and adjacent surfaces.

3.6 CLEANING

A. Section 01 70 00 – Closeout Requirements: Requirements for cleaning.

B. Remove excess mortar and mortar smears as Work progresses.

C. Promptly remove excess wet mortar containing integral water repellent mortar admixture from the face of the masonry as work progresses. Refer to admixture manufacturer for proper cleaning procedures.

D. Replace defective mortar. Match adjacent Work.

E. Clean soiled surfaces with cleaning solution.

F. Use non-metallic tools in cleaning operations.

G. Remove efflorescence from masonry wall exposed in the finished work in accordance with manufacturers' recommendations and NCMA TEK Bulletin #8-01A, #8-02A, #8-03A & #8-04A.

3.7 CMU WATER REPELLENT

A. Immediately after final cleaning. Apply CMU water repellent to exterior and interior surfaces as called out in Room Finish Schedule. See Section 07 19 00 –Water Repellents (Masonry).

3.8 PROTECTION

A. Section 01 70 00 –Closeout Requirements: Requirements for protecting finished Work.

B. Hot and Cold Weather Construction: Perform Work according to ACI 530.1, 1.8.

C. Protect exposed external corners subject to damage.

D. Protect base of walls from mud and mortar splatter.

E. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.

F. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when Work is not in progress.

G. Protect Work from rain by performing Work under protective cover.

END OF SECTION

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SECTION 05 04 10
HOT-DIP GALVANIZING

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section specifies hot-dip galvanizing for all miscellaneous and structural steel exposed to the weather, moisture, or corrosive atmosphere including but not limited to the following:

1. Structural steel where indicated on the Drawings and in these Specifications.

2. Items identified in other Sections of these Specifications.

B. Definitions

1. Hot-Dip Galvanizing: The dipping of steel members and assemblies into an alloy of molten special high-grade zinc and other earthly materials for lasting long-term protection.

2. The resultant zinc alloys with the base metal.

1.2 REFERENCE STANDARDS

A. Comply with applicable portions of the following reference standards:

1. American Galvanizers Association Inc. (AGA): Publication entitled "Inspection Manual for Hot-Dip Galvanized Products."

2. ASTM International (ASTM):

a. A123 - Zinc (Hot Galvanized) Coating on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, and Hardware.

b. A153 - Zinc Coating (Hot Dip) on Iron and Steel Hardware.

c. A143 - Safeguarding Against Embrittlement.

d. A384 - Safeguarding Against Warpage.

e. A385 - Providing High Quality Zinc Coatings.

f. A780 - Repair of Hot-Dip Galvanizing.

1.3 SUBMITTALS

A. Certificate of Compliance from Galvanizer: Submit notarized Certificate of Compliance with application for payment for galvanizing, signed by galvanizer, indicating compliance with requirements of specifications. Include scope of services provided, and quantity and itemized description of items processed.

B. Visual Stamp: The galvanizer shall mark all lots of material with a clearly visible stamp or tag indicating the name of the galvanizer, the weight of the zinc coating, and the applicable ASTM Specification Numbers.

1.4 QUALITY ASSURANCE

A. Coordination Between Fabricator and Galvanizer: Prior to fabrication, direct fabricator to submit approved shop drawings to the galvanizer for all fabrications. Direct galvanizer to review fabricator's shop drawings for suitability of materials for galvanizing and coatings and coordinate any required modifications to fabrications required to be done by the fabricator.

B. Steel Materials: For steel to be hot dip galvanized, provide steel chemically suitable for metal coatings complying with the following requirements: Carbon below 0.25 percent, silicon below 0.24 percent, phosphorous below 0.05 percent, and manganese below 1.35 percent. Notify galvanizer if steel does not comply with these requirements to determine suitability for processing.

1. To prevent unnecessary damage to the galvanized coating by field welding, provide slip fit method of connecting pipe railings. Fabricate pipe railing from mechanical steel tubing internally vented with holes 3/4 the size of the pipe's internal diameter. For other fabrications, bolted connections shall be used wherever possible.

2. Assemblies: Where size of assembly is too large for galvanizing kettle, galvanize components prior to fabrication and assemble after galvanizing.

C. Engage the service of a galvanizer who has demonstrated a minimum of five (5) years experience in the successful performance of the processes outlined in this specification in the facility where the work is to be done and who will apply the galvanizing and coatings within the same facility as outlined herein. The Authority has the right to inspect and approve or reject the galvanizer/ galvanizing facility.

D. The galvanizer/galvanizing facility must have an ongoing Quality Control/Quality Assurance program acceptable to the Authority which has been in effect for a minimum of five years and shall provide the Authority with process and final inspection documentation.

E. The galvanizer/galvanizing facility must have an on-premises testing facility capable of measuring the chemical and metallurgical composition of the galvanizing bath and pickling tanks.

F. In process paint application shall be monitored with a wet film gage and the measurements recorded. Dry film thickness measurement shall be by Tooke Gage and Magnetic Coating Thickness gage.

G. Provide and apply materials complying with environmental requirements of authority having jurisdiction. All materials shall be delivered to the galvanizer with label or product data sheet affixed to the manufacturer's containers showing the manufacturer's name, batch number, type of paint, stock number, label analysis of solids and vehicle, reducing and thinning instructions, drying and recoat time, Material Safety Data Sheets (MSDSs), recommended application procedures and environmental restrictions. Paint materials shall be stored in an acceptable location reserved only for such materials and related equipment in compliance with applicable local health and fire regulations and Occupational Safety and Health Administration (OSHA) requirements.

H. The galvanizer/galvanizing facility must have a dedicated, on-premises painting and curing facility for the exclusive use of coating galvanized steel. Said facility shall utilize the following:

1. Recording hygrometer to measure air temperature and humidity.

2. A spray booth confirming OSHA regulations with filtered exhaust.

3. A convection hot air curing system with solvent vapor removal liability.

4. The curing booth shall be heated using an indirect thermostat-controlled gas fired forced hot air blower. The booth shall be protected with a sprinkler system complying with National Fire Protection Agency (NFPA) 15. The air in the curing booth shall be continuously monitored by a lower explosive limit (LEL) monitoring device connected to the ventilation system. The booth shall be capable of reaching 150°F with a sustained capability of 100°F.

PART 2 PRODUCTS

2.1 HOT-DIP GALVANIZING

A. Provide coating for iron and steel fabrications applied by the hot-dip process, Comply with ASTM A123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. The galvanizing bath shall contain special high-grade zinc.

B. If, for any reason, the galvanizing item is to be primed (for future field painting or finish coated), the coatings shall be applied by the galvanizer at same facility, within 12 hours of galvanizing, in accordance with Section 09 91 00.

C. Field priming of hot dip galvanizing will not be permitted.

D. Safeguard against embrittlement in conformance with ASTM A143.

E. Warpage or Distortion Prevention:

1. To safeguard against warpage or distortion of steel members, in conformance with ASTM A384, steel fabricator shall submit shop drawings of non-standard fabrications, all tubular fabrications, all fabrications involving any dimension which exceeds the size of the galvanizer's kettle, and any fabrication involving materials of different thicknesses.

2. Submit these drawings to the galvanizer before fabrication to determine the suitability of the material for galvanizing.

F. To prevent unnecessary damage to the finished coating by field welding, use bolted connections for field connections wherever possible.

G. To ensure a smooth even coating, pipe rails should be fabricated from mechanical steel tubing with "slip fit" type connections.

PART 3 EXECUTION

3.1 APPLICATION OF GALVANIZING AND METAL COATINGS

A. Galvanize materials in accordance with referenced standards and this specification.

B. Galvanizing shall provide an acceptable substrate for applied coatings.

C. The dry kettle process shall be used to eliminate any flux inclusions on the surface of the galvanized material. Prior to galvanizing, the steel shall be immersed in a pre-flux solution (zinc ammonium chloride). The pre-flux tanks must be 12o to 14o Baume' and contain less than 0.4 percent iron. The wet kettle process shall be prohibited.

D. To provide the galvanized surface required, the following procedures shall be implemented:

1. A monitoring recorder shall be utilized and inspected regularly to observe any variances in the galvanizing bath temperature.

2. The pickling tanks shall contain hydrochloric acid with a constant range between 10-14 percent, iron content less than eight percent and zinc content less than three percent. Titrations shall be taken weekly at a minimum.

3. Rinse tanks, for the removal of cleaning chemicals, shall contain water.

4. Water quenching of galvanized steel shall be prohibited.

E. Installation: Comply with fabricator's and galvanizer's requirements for installation of materials and fabrications, including use of nylon slings or padded cables for handling factory-primed or factory-finished materials.

F. Touch-Up and Repair: For damaged and field-welded metal coated surfaces, clean welds, bolted connections, and abraded areas.

1. At galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A780. Galvanizing repair paint shall have 95 percent zinc by weight, ZIRP by Duncan Galvanizing. Thickness of applied galvanizing repair paint shall be not less than coating thickness required ASTM A123 or A153 ass applicable. Touch-up of galvanized surfaces with aerosol spray, silver paint, bright paint, brite paint, or aluminum paints is not acceptable.

2. At factory-primed or factory-finished surfaces, touch-up finish in conformance with manufacturer's recommendations. Provide touch-up such that repair is not visible from six feet away.

3. The galvanizer/galvanizing facility must have an ongoing touch-up and repair program acceptable to the Authority which has been in effect for a minimum of five years.

4. A touch-up repair kit shall be provided with each order.

PART 4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for hot-dip galvanizing will be measured as being included in the contract lump sum or unit price for said item.

4.2 PAYMENT

A. Hot-Dip galvanizing will be paid for at the Contract price as specified above.

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural Shapes

B. Channels and Angles

C. Hollow Structural Sections

D. Structural Pipe

E. Structural Plates and Bars

F. Floor Plates

G. Fasteners, Connectors, and Anchors

H. Grout

1.2 RELATED SECTIONS

A. Division 1

B. Division 3

C. Division 4

D. Division 5

E. Division 9

1.3 REFERENCES

A. American Institute of Steel Construction (AISC)

1. AISC Code of Standard Practice for Steel Buildings and Bridges

2. AISC Seismic Provisions for Structural Steel Buildings

3. AISC Specification for Allowable Stress Design of Single-Angle Members

4. AISC Specification for the Design of Steel Hollow Structural Sections

5. AISC Specification for Structural Steel Buildings Allowable Stress Design, and Plastic Design

B. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
8. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
9. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
10. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
11. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts
12. ASTM A786 - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
13. ASTM A992 - Standard Specification for Structural Steel Shapes
14. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
15. ASTM E94 - Standard Guide for Radiographic Examination
16. ASTM E164 - Standard Practice for Ultrasonic Contact Examination of Weldments
17. ASTM E165 - Standard Test Method for Liquid Penetrant Examination
18. ASTM E709 - Standard Guide for Magnetic Particle Examination

19. ASTM F436 - Standard Specification for Hardened Steel Washers

20. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

C. American Welding Society (AWS):

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination

2. AWS D1.1 - Structural Welding Code - Steel

D. Research Council on Structural Connections (RCSC):

1. RCSC - Specification for Structural Joints Using ASTM A325 or A490 Bolts

E. The Society for Protective Coatings (SSPC):

1. SSPC - Steel Structures Painting Manual

2. SSPC Paint 15 - Steel Joist Shop Paint

3. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)

4. SSPC SP 3 - Power Tool Cleaning

5. SSPC SP 6 - Commercial Blast Cleaning

6. SSPC SP 10 - Near-White Blast Cleaning

1.4 SUBMITTALS

A. Submit under provision of Section 01 33 00.

B. Shop Drawings:

1. Indicate profiles, sizes, spacing, location of structural members, openings, attachments, and fasteners.

2. Connections.

3. Cambers.

4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following:

1. AISC Code of Standard Practice for Steel Buildings and Bridges.

1.6 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this Section with minimum five years experience.

B. Erector: Company specializing in performing Work of this Section with minimum five years experience.

C. Shop Painter: Company specializing in performing Work of this Section with minimum five years experience.

D. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months.

1.7 COORDINATION

A. Coordinate work with all effected trades.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural W-Shapes: ASTM A992; Grade 50

B. Structural T-Shapes: Cut from structural W-shapes

C. Channels and Angles: ASTM A36

D. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade C

E. Structural Pipe: ASTM A53, Grade B

F. Structural Plates and Bars: ASTM A36

G. Floor Plates: ASTM A786; raised pattern

2.2 FASTENERS, CONNECTORS, AND ANCHORS

A. High Strength Bolts: ASTM A325; Type 1

1. Finish: Unfinished

B. Nuts: ASTM A563 heavy hex type, Grade DH

1. Finish: Unfinished

C. Washers: ASTM F436; Type 1, circular. Furnish clipped washers where space limitations require

1. Finish: Unfinished

D. Anchor Rods: (Bolts set into concrete) ASTM F1554; Grade 55

1. Shape: Straight-Headed

2. Nuts for anchor rods to be ASTM A563, Grade A, Heavy Hex.

2.3 WELDING MATERIALS

A. Welding Materials: AWS D1.1; type required for materials being welded

2.4 ACCESSORIES

A. Grout for Steel Bearing Plates: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 7,000 psi.

B. Shop and Touch-Up Primer and Paint: Per Division 9.

2.5 FABRICATION

A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.

B. Fabricate connections for bolt, nut, and washer connectors.

C. Develop required camber for members.

2.6 FINISH

A. Prepare structural component surfaces in accordance with SSPC SP 3.

B. Painting and Coatings: Per Division 9. Do not prime surfaces that will be field welded, in contact with concrete, or high strength bolted.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 40 00 – Quality Assurance and Quality Control: Construction observation and testing laboratory service.

B. Shop test bolted and welded connections as specified for field quality control tests.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify bearing surfaces are at correct elevation.

B. Verify anchors rods are set in correct locations and arrangements with correct exposure for steel attachment.

3.2 PREPARATION

A. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

3.3 ERECTION

A. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.

B. Field weld components indicated on shop drawings.

C. Field connect members with threaded fasteners; torque to required resistance.

D. Do not field cut or alter structural members without approval of Architect/Engineer.

E. After erection, touch up welds and abrasions to match shop finishes.

3.4 GROUT INSTALLATION

A. Grout under base plates in accordance with Section 03 60 00.

B. Remove forms after grout is set. Trim grout edges to from smooth surface, splayed 45 degrees.

C. Tighten anchor bolts after grout has cured for a minimum of three days.

3.5 ERECTION TOLERANCES

A. Section 01 40 00 – Quality Assurance and Quality Control: Tolerances.

B. Maximum Variation from Plumb: ¼ inch per story, non-cumulative.

C. Maximum Offset from Alignment: ¼ inch.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Assurance and Quality Control.

B. Bolted Connections: Inspect in accordance with AISC specifications.

1. Visually inspect all bolted connections.

C. Welding:

1. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.

2. Visually inspect all welds.

D. Correct defective bolted connections and welds.

END OF SECTION

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes shop fabricated metal items.

1. Bollards
2. Ladders
3. Miscellaneous piping and duct support frames.
4. Structural supports for miscellaneous attachments.
5. Entry Canopies
6. Window Shades
7. Roof Access Ladders
8. Exterior Fire Extinguisher Support *(at Bulk Chemical Storage)*
9. Miscellaneous metal items and fabrications not otherwise covered in the plans or specifications.
10. Anchors for Equipment.
11. Garage door shelf angle and anchors.

B. Related Sections:

1. Division 1
2. Division 3
3. Division 4
4. Division 5
5. Division 9

1.2 REFERENCES

A. Aluminum Association (AA):

1. AA DAF-45 - Designation System for Aluminum Finishes

B. American Architectural Manufacturers Association (AAMA):

1. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum

C. ASTM International (ASTM):

1. ASTM A36 – Standard Specification for Carbon Structural Steel

2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

3. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

4. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

5. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

6. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes.

7. ASTM A297 – Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application

8. ASTM A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

9. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

10. ASTM A312 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes

11. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

12. ASTM A354 – Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

13. ASTM A479 – Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

14. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

15. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

16. ASTM A554 – Standard Specification for Welded Stainless Steel Mechanical Tubing

17. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts

18. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

19. ASTM A992 – Standard Specification for Structural Steel Shapes

20. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings

21. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings

22. ASTM B177 – Standard Guide for Chromium Electroplating on Steel for Engineering Use

23. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

24. ASTM B210 – Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

25. ASTM B211 – Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire

26. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

27. ASTM B695 – Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

28. ASTM F436 – Standard Specification for Hardened Steel Washers

29. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

D. American Welding Society (AWS):

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination

2. AWS D1.1 - Structural Welding Code - Steel

3. AWS D1.6 - Structural Welding Code - Stainless Steel

E. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. NOMMA Guideline 1 - Joint Finishes

F. The Society for Protective Coatings (SSPC):

1. SSPC - Steel Structures Painting Manual

2. SSPC SP 1 - Solvent Cleaning

3. SSPC SP 10 - Near-White Blast Cleaning

4. SSPC Paint 15 - Steel Joist Shop Paint

5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Division 1: Product storage and handling requirements.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.5 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on drawings.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A992; Grade 50.

B. Steel Plate: ASTM A36.

C. Hollow Structural Sections: ASTM A500, Grade C.

D. Steel Pipe: ASTM A53, Grade B Schedule 40, unless noted otherwise on plans.

E. Sheet Steel: ASTM A653, Grade 33 Structural Quality with galvanized coating.

F. Bolts: ASTM A307; Grade A or B.

1. Finish: Hot dipped galvanized.

G. Nuts: ASTM A563 heavy hex type.

1. Finish: Hot dipped galvanized.

H. Washers: ASTM F436; Type 1.

1. Finish: Hot dipped galvanized.

I. Welding Materials: AWS D1.1; type required for materials being welded.

J. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

K. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic zinc rich.

2.2 MATERIALS - STAINLESS STEEL

A. Bars and Shapes: ASTM A276; Type 316.

B. Tubing: ASTM A269; Type 316.

C. Pipe: ASTM A312, seamless; Type 316.

D. Plate, Sheet, and Strip: ASTM A167; Type 316.

E. Bolts, Nuts, and Washers: ASTM A354.

F. Welding Materials: AWS D1.6; type required for materials being welded.

2.3 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.

B. Sheet Aluminum: ASTM B209, Alloy 6061, Temper T6.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210, Alloy 6061, Temper T6.

D. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.

E. Bolts, Nuts, and Washers: Stainless steel.

F. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 MATERIALS – BLIND SIDE FASTENERS

A. Where bolted connections are indicated to be made to HSS shapes or other places where access is unavailable to the back side of the fastener provide Type HB - Hollo-Bolt by Lindapter or approved equal.

B. Bolt size shall be as indicated on the plans for the thickness of materials to be joined as indicated. Install bolts per the manufacturer's specifications. Provide stainless steel fasteners for all exterior applications and where indicated.

2.5 COORDINATION:

A. BOLLARDS

1. Bollards: Steel pipe, concrete filled, crowned cap, 6-inches diameter, length as indicated on Drawings; prime paint plus one coat of high-visibility yellow paint. Coordinate with typical bollard detail (CD-114).

2. Concrete Fill: Mix number M2500-GFM per General Concrete Notes on the project drawings and as referenced/specified in Section 03 30 00.

3. Anchors: Concealed type as indicated on Drawings.

B. LADDERS

1. Fixed Ladders shall be in conformance with American National Standards Institute (ANSI) Standard A14.3 – Safety Requirements for Fixed Ladders; and Occupational Safety and Health Administration (OSHA) Regulation 1910.27 – Standards for Fixed Ladders.

2. Fixed Ladder: Stainless Steel or Aluminum, welded construction:

3. Side Rails: 3/8- by 2-inch minimum side rails spaced at 16-inches clear, minimum.

4. Rungs: Minimum one-inch diameter solid rod with gritted surface or manufactured rungs with safety gripping surface, uniformly spaced 12-inches on center.

5. Mounting: Space rungs a minimum of seven inches clear from wall surfaces; with mounting brackets and attachments.

6. Finish: Stainless Steel, Mill finish. Aluminum, Clear anodized finish.

7. Ladder Walk-through Extensions: Where indicated on the plans or required by Safety Codes provide walk-through ladder rail extensions in conformance with ANSI and OSHA regulations. Same material and finish as ladder.

C. Miscellaneous piping and duct support frames.

1. Provide where indicated on the drawings or required to provide safe/stable support to piping and ducting for both gravity, dynamic and seismic loads.

2. Steel per Article 2.1 of this Specification.

3. Hot-dip galvanized where noted on the Drawings.

4. Three coat paint system per Section 09 96 00 – Protective Coatings, where not otherwise indicated on the Drawings.

D. Garage door shelf angle.

1. See architectural plans.

2.6 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.7 FACTORY APPLIED FINISHES - STEEL

A. Galvanizing: ASTM A123; minimum 2.0 ounces/square foot coating thickness; galvanize after fabrication.

1. Galvanizing for Fasteners, Connectors, and Anchors:

2. Hot-Dipped Galvanizing: ASTM A153.

B. Painted: Provide three coat paint system per Section 09 96 00 – Protective Coatings, where finish is not otherwise indicated on the Drawings.

2.8 FACTORY APPLIED FINISHES - STAINLESS STEEL

A. Satin Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.

2.9 FACTORY APPLIED FINISHES - ALUMINUM

A. Finish coatings to conform to AAMA 2603. Comply with AA DAF-45.

B. Exterior Aluminum Surfaces: AAMA A41 anodized, prepared with chemical pre-treatment, anodized to clear color.

2.10 FABRICATION TOLERANCES

A. Squareness: 1/8-inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16-inch.

C. Maximum Misalignment of Adjacent Members: 1/16-inch.

D. Maximum Bow: 1/8-inch 48-inches.

E. Maximum Deviation from Plane: 1/16-inch in 48-inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 1: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip galvanized steel items to bare metal where site welding is required. After welding coat affected surfaces with a cold galvanizing compound.

B. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment, until permanent bracing and attachments are installed.

C. Field weld components only as indicated on Drawings.

D. Perform field welding in accordance with AWS D1.1.

E. Obtain approval of Engineer prior to site cutting or making adjustments not scheduled.

F. After erection, touch up welds, abrasions, and damaged finishes with galvanizing repair paint to match shop finishes.

3.4 ERECTION TOLERANCES

A. Section 01 40 00 – Quality Assurance and Quality Control: Tolerances.

B. Maximum Variation from Plumb: ¼-inch per story or for every 12 ft in height whichever is greater, non-cumulative.

C. Maximum Offset from Alignment: ¼-inch.

D. Maximum Out-of-Position: ¼-inch.

END OF SECTION

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SECTION 05 51 00
METAL STAIRS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal stair systems with integral landings, balusters and railings consisting of painted steel or aluminum stingers and support structure.

2. Aluminum treads, grating, balusters, and railings.

3. Painted steel or aluminum support frames of structural sections.

4. Open grate stair treads with open risers and landings.

5. Integral balusters and guard railing.

6. Separate hand-railing.

7. Provide all aluminum stair systems unless specifically approved otherwise on the Drawings or by the Engineer.

B. Related Requirements:

1. Section 03 30 00 – Cast-In-Place Concrete

2. Section 05 50 00 – Metal Fabrications

3. Section 05 52 50 – Aluminum Handrails and Railings

4. Section 09 96 00 – Protective Coatings

1.2 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel.

2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

3. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

4. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

5. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

6. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.

7. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.

8. ASTM A786 - Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.

9. ASTM A992 - Standard Specification for Structural Steel Shapes.

10. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

11. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

12. ASTM F436 - Standard Specification for Hardened Steel Washers.

13. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

B. American Welding Society (AWS):

1. AWS A2.4 - Standard Symbols for Welding, Brazing, Nondestructive Examination.

2. AWS D1.1 - Structural Welding Code - Steel.

C. National Association of Architectural Metal Manufacturers (NAAMM):

1. NAAMM AMP 510 - Metal Stairs Manual.

2. NAAMM MBG 531 - Metal Bar Grating Manual.

D. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. NOMMA Guideline 1 - Joint Finishes.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders' Certificates: Certify welders and welding procedures employed on the Work, verifying AWS qualification within previous 12 months.

D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations for each stair system required for the project.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 QUALITY ASSURANCE

A. Perform railing work according to ASTM E985.

B. Finish joints according to NOMMA Guideline 1.

1.5 QUALIFICATIONS

A. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.

B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' experience.

C. Erector: Company specializing in performing Work of this Section with minimum three years’ experience.

D. Licensed Professional: When required, Professional engineer experienced in design of specified Work and licensed in State of Colorado.

1.6 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Fabricate stair assembly to support uniform live load of 100-pounds/square feet and/or concentrated load of 300 pounds, whichever imposes the maximum effect on the member.

B. Deflection of stringer or landing framing not to exceed 1/360 of span.

C. Railing assembly, wall rails, and attachments to resist lateral force of 200-pounds at any point without damage or permanent set.

D. At a minimum all structural (lateral) systems shall be designed to support a minimum lateral point load of 500-pounds applied at the point of maximum effect.

E. Fabricate stair assembly to NAAMM AMP 510, industrial service class.

F. Design to be performed under the supervision of a Professional Structural Engineer currently registered in the State of Colorado.

2.2 MATERIALS

A. Structural W-Shapes: ASTM A992.

B. Structural T-Shapes: Cut from structural W-shapes.

C. Channels and Angles: ASTM A36.

D. Round Hollow Structural Sections: ASTM A500, Grade C.

E. Square and Rectangular Hollow Structural Sections: ASTM A500, Grade C.

F. Structural Pipe: ASTM A53, Grade B.

G. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.

H. Structural Plates: ASTM A53.

I. Aluminum Sections (Channels & I-Beams): ASTM B221 Alloy 6061 Temper T6

J. Bolts: ASTM A193, Grade B8M, Class 1 or 2, Type 316.

1. Finish: Stainless Steel.

K. Nuts: ASTM A194, Grade 8M, heavy-hex.

1. Finish: Stainless Steel.

L. Washers:

1. For ASTM A193 Bolts: SS316.

a. Finish: Stainless Steel.

2. For ASTM A325 Bolts: ASTM F436, Type 1.

a. Finish: Stainless Steel.

M. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; consistent with design of stair structure.

N. Welding Materials: AWS D1.1; type required for materials being welded.

O. Gratings: NAAMM MBG 531, Type: Welded Aluminum.

P. Stair Treads: Aluminum fabricated bar grate stair treads with rolled plate nosing with abrasive nosing.

2.3 FABRICATION

A. Fit and shop-assemble components in largest practical sections, for delivery to Site.

B. Fabricate components with joints tightly fitted and secured.

C. Continuously seal joined pieces by continuous welds.

D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Accurately form components required for anchorage of stairs, landings and railings to each other and to building structure.

I. Open Grating Stairs and Landings:

1. Fabricate treads 1 1/2-inch minimum depth according to NAAMM MBG 531, of welded aluminum bar grating bolted to supports; factory finish.

2. Form stringers with rolled-steel channels.

3. Form landings 1 ½-inch minimum depth according to NAAMM MBG 531, of welded aluminum bar grating with factory finish. Reinforce underside with steel angles or tees to attain design load requirements.

4. Balusters, guard rail and hand-railing per Section 05 52 50 – Aluminum Handrails and Railings; Anodized finish.

J. Stair Support Frames:

1. Fabricate self-supporting steel/aluminum stair support frames including support columns, beams and bracing to support the stair system; sectioned for transport.

K. Painted Finish; All supporting steel stringers and framework shall be painted per Section 09 96 00 after fabrication.

1. Touch-up damaged painted areas as approved by the Engineer.

2.4 FINISHES

A. Aluminum:

1. Clear anodized.

2. Fasteners shall be stainless steel as specified on sheet S-001

B. Steel:

1. Painted.

2. Fasteners: Stainless Steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive Work.

B. Verify that concealed blocking and reinforcement is installed and correctly located to receive wall-mounted handrails.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where Site welding is required.

1. Paint welded areas per Section 09 96 00 when complete.

B. Supply items required to be cast into concrete and or embedded in masonry with setting templates.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Install anchors, plates and angles required for connecting stairs to structure.

C. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.

D. Field-weld components only where specifically indicated on Drawings. Perform field welding according to AWS D1.1.

E. Field-bolt and -weld to match shop bolting and welding. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

F. Mechanically fasten joints butted tight, flush, and hairline. Grind welds smooth and flush.

G. Obtain approval of Engineer prior to Site cutting or creating adjustments not scheduled.

3.4 TOLERANCES

A. Section 01 40 00 – Quality Assurance and Quality Control: Requirements for tolerances.

B. Maximum Variation from Plumb: ¼- inch per story, noncumulative.

C. Maximum Offset from Alignment: 1/4-inch.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Assurance and Quality Control: Requirements for inspecting and testing.

B. Inspection: Inspect welds according to AWS D1.1.

END OF SECTION

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SECTION 05 52 50
ALUMINUM HANDRAILS AND RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes aluminum balusters, guard and hand railings and fittings.

B. Related Sections:

1. Section 01 20 00 – Measurement and Payment
2. Section 01 33 00 – Submittal Procedures.
3. Section 03 30 00 – Cast-In-Place Concrete.
4. Section 05 50 00 – Metal Fabrications.
5. Section 05 51 00 – Metal Stairs.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

B. ASTM International (ASTM):

1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. ASTM B241 - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
3. ASTM B483 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tubes for General Purpose Applications.
4. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.

C. National Ornamental & Miscellaneous Metals Association (NOMMA):

1. NOMMA Guideline 1 - Joint Finishes.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.4 QUALITY ASSURANCE

A. Finish joints in accordance with NOMMA Guideline 1.

1.5 FIELD MEASUREMENTS

A. Verify field measurements for railing lengths, elevations, and support locations prior to fabrication.

PART 2 PRODUCTS

2.1 ALUMINUM RAILING SYSTEM COMPONENTS

A. Guard Rails and Posts: 2-inch nominal outside diameter, extruded tubing conforming to B211. Hand Rails to be 1-1/2-inch nominal outside diameter, extruded tubing in conformance with current International Building Code profile requirements.

B. Fittings: Fabricated, machined or cast plates, angles and brackets as indicated on the drawings; aluminum.

C. Mounting: Brackets and flanges, with stainless steel anchors either cast in place or drilled in the field and set in place with approved construction adhesive into concrete support surfaces.

D. Splice Connectors: Concealed with locking set stainless steel screws; aluminum.

E. Exposed Fasteners: Flush countersunk stainless steel screws or bolts; consistent with design of railing.

F. Finish coatings to conform to AAMA 611.

G. Exterior Aluminum Surfaces: AAMA A41 anodized, prepared with chemical pre-treatment, anodized to clear color.

H. Apply two coats of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.2 MANUFACTURER

A. Unless otherwise directed all Guard and Handrail shall be fabricated utilizing the Speed-Rail System by Hollaender Manufacturing of Cincinnati, Ohio. (Hollaender.com)

1. Golden Railings Inc. of Broomfield, Colorado is also acceptable (303-279-5807)

B. Railing extend, slopes and elevations shall be as detailed on the Drawings and as directed by the Engineer.

C. All posts and horizontals shall be aluminum pipe per Section 2.1 of this Specification.

D. All fittings and connectors shall be Aluminum-Magnesium Alloy as provided by Hollaender Manufacturing.

E. All components including vertical and horizontal pipe and fittings and connections shall be anodized coated. Color of anodizing shall be as directed and approved by the Owner.

2.3 FABRICATION

A. Fit and shop assemble components in largest practical sizes for delivery to site.

B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

E. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.

F. Interior Components: Continuously seal joined pieces by continuous welds.

G. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

H. Accurately form components to suit stairs and landings, to each other and to adjacent structures and/or equipment.

I. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

J. Extend handrails past last stair step with returns in conformance with current International Building Code requirements.

K. Close all open pipe ends with smooth aluminum plugs as furnished by the approved manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Division 01: Coordination and project conditions.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Clean and strip aluminum where site welding is required.

B. Supply items required to be cast into concrete embedded in masonry with setting templates, to appropriate sections.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.

B. Anchor railings to structure with anchors as indicated on the drawings.

C. Field weld only where indicated on the drawings or approved by the Engineer. Grind field welds smooth and Touch-up welded areas with a field coating compatible with the railing finish.

D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

3.4 ERECTION TOLERANCES

A. Maximum Variation from Plumb: ¼-inch per story, non-cumulative.

B. Maximum Offset from Alignment: ¼-inch.

C. Maximum Out-of-Position: ¼-inch.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 WORK INCLUDED

A. Include all labor, materials, equipment, transportation, and services required to complete all rough carpentry as shown on the drawings and herein specified.

1.2 STANDARDS

A. INDUSTRY STANDARDS AND CODES

1. Grading Rules for Western Lumber, 4th Edition, May 15,1977 (WWPA).

2. Product Standard PS 1-74, materials as quality tested by American Plywood Association as revised June 1978 (APA).

3. International Building Code, 2018 Edition.

1.3 PROTECTION

A. Protect lumber from damage by weather or other causes before, during and after installation. All kiln-dried lumber shall be covered and stored off the ground.

PART 2 PRODUCTS

2.1 MATERIALS

A. LUMBER

1. All lumber shall be delivered to job bearing grade stamps (WCLB).

2. All lumber shall be furnished surfaced S4S.

3. All lumber shall be furnished with 19% maximum moisture content unless otherwise specified.

4. Framing lumber shall be furnished of the species and stress grades as noted on the structural drawings. Sizes of members as shown and noted on the drawings.

5. Lumber for stripping and furring shall be furnished kiln dried to 15% maximum moisture content and of the following species and grade:

a. Sized nominal 1 inch thick: Douglas Fir, BOARDS - CONSTRUCTION.

b. Sized nominal 2 inches thick: Douglas Fir, LIGHT FRAMING - CONSTRUCTION.

B. PLYWOOD

1. All plywood shall be delivered to job bearing grade stamps (APA).

2. Plywood thickness as shown on the drawings.

3. Plywood grades as shown on the drawings.

C. MISCELLANEOUS

1. Building Paper: Kraft Sheathing paper, asphalt saturated, equal to American Tar Company #304.

D. ROUGH HARDWARE

1. Frame Anchors, Hangers: Bowman, Silver Metal, Simpson or Teco. Configuration and type shown or to fit conditions. Heavy duty type at least 18 gauge, galvanized, I.B.C. approved furnished with proper nails to fit conditions of supports. Install all connectors per manufacturers recommendations.

2. Bolts, Lag Screws: Size as shown, herein specified or to I.B.C. Furnished galvanized with nuts, washers, and lockwashers (all bolts).

PART 3 EXECUTION

3.1 INSTALLATION – GENERAL

A. TREATED LUMBER

1. All lumber, interior or exterior locations, in contact with concrete or masonry shall be "treated".

2. All lumber for roof curbs, cants shall be “treated”.

3. Treatment specified in Section 06 30 00.

B. JOISTS – CEILING ROOF

1. Set to provide at least 3 inches of bearing.

2. Set with crown up.

3. Install metal hangers, frame anchors where shown or needed for proper connections.

4. Provide headers around openings.

5. Provide bridging: cross-bridging at 8-foot maximum centers on spans exceeding 8 feet. Use 1 x 3 or prefabricated metal.

6. Block at ends at bearing, 2-inch nominal thick by full depth of member.

C. NAILING

1. As herein specified to I.B.C. Chapter 23, Table 2304.9.1 minimum unless noted otherwise on the drawings.

D. PLYWOOD or OSB SHEATHINGS

1. Apply with face grains of sheets across supports, end joints staggered. End joints to occur on framing members.

2. Nails: galvanized, ring or anchor shank.

3. Space panels 1/16 inch at ends and 1/8 inch at edges. Double spacing during installation when wet or humid conditions exist.

4. Nailing: minimum unless noted otherwise on the drawings.

   a. Roof sheathing: 8d to 6-inch centers along panel edges and 12-inch centers at intermediate supports unless noted otherwise.

   b. Blocking panels: 16d at 6-inch centers along panel edges, unless noted otherwise.

E. ROOF BLOCKINGS

1. Roof sheathing: one ply clip between each bearing member each side of each panel if solid blocking is not called for on the drawings.

F. WOOD TRUSSES

1. Receive, store and protect until required for installation.

2. Erect to detail and approved shop drawings.

3. Brace and stabilize until other structural components of assemblies are installed.

G. BEAMS, POSTS, LEDGERS

1. Receive, store and protect until required for installation.

2. Erect to detail and/or approved shop drawings.

H. MISCELLANEOUS (To Drawing Details)

1. Install all work straight, plumb and true.

2. Furnish and install all nails, spikes, bolts, clips, hangers, and miscellaneous fastenings shown, specified or necessary to draw and hold members rigidly and permanently in place.

END OF SECTION

SECTION 06 19 30
PLATE CONNECTED WOOD TRUSSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated wood trusses for roof framing.

B. Bridging, bracing and anchorage.

1.2 REFERENCES

A. ASTM A446 – Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

B. NFPA: National Forest Products Association.

C. TPI (Truss Plate Institute) BWT-76 – Bracing Wood Trusses.

D. TPI (Truss Plate Institute) HET-80 – Handling and Erecting Wood Trusses.

E. TPI (Truss Plate Institute) TPI-85 – Metal Plate Connected Wood Trusses.

F. TPI (Truss Plate Institute) QST-88 – Metal Plate Connected Wood Trusses.

G. WWPA: Western Wood Products Association.

1.3 SUBMITTALS

A. Shop Drawings: Indicate sizes and spacing of trusses and loads and truss cambers.

B. Product Data: Provide truss configurations, bearing and anchor details, bridging and bracing, and splice connection.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by ALSC

2. Plywood Grading Agency: Certified by APA

B. Trusses shall be manufactured and erected in accordance with the specifications and the manufacturer's approved drawing. Where there is evidence that any truss or trusses do not meet the specification requirements or are potentially deficient as determined by the Engineer, trusses will be removed and tested. Any truss shall be considered potentially deficient if it fails to comply with any of the requirements which control its deflection capability or load-carrying capacity, including conditions such as poor

workmanship, improperly installed connection plates, improperly fabricated connections, damaged or substandard wood or steel members of connections and non-conformance with the manufacturer's design drawings.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section.

B. Design trusses under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Colorado. See Structural Drawings for additional design requirements.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable code for loads, seismic zoning, other governing load criteria.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and erect trusses in accordance with TPI HET-80.

B. Store trusses in vertical position testing on bearing ends.

1.8 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber Grading Rules: WWPA.

B. Steel Connectors: ASTM A446 steel, Grade A and C galvanized.

2.2 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses in accordance with TPI BWT-76.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

A. Coordinate placement of support items.

B. Store trusses at the site in a vertical position, off the ground and protected from inclement weather until installation.

3.3 ERECTION

A. Install trusses in accordance with manufacturer's instructions.

B. Set members level and plumb, in correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing. Temporary construction loads which cause member stresses beyond design limits, are not permitted.

D. Do not field cut or alter structural members without approval of Engineer.

E. All joists shall be anchored to support and shall set to accurate alignment, both vertically and horizontally.

3.4 TOLERANCES

A. Framing Members: ¼ inch maximum from true position.

END OF SECTION

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SECTION 06 30 00
WOOD PRESERVATIVE TREATMENT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Includes all labor, materials, equipment, transportation, and services necessary to treat wood members for location as herein specified or shown on the drawings.

1.2 STANDARD SPECIFICATIONS

A. American Wood Preservers Institute.

1.3 SUBMITTALS

A. CERTIFICATE

1. Furnish affidavit from treating plant stating that all treated wood conforms with specifications and that moisture content, after treatment, does not exceed limits specified.

PART 2 PRODUCTS

2.1 MATERIALS

A. Water Borne Preservatives (LP/22), Penta Sol (LP3/33), Solution (LP/44), or Creosote (LP5/55).

2.2 TREATMENT

A. Where possible, pre-cut lumber before treatment.

B. Pressure impregnate wood materials in accordance with standard specifications. Identify each treated number member with brand name and name of procedure.

C. Dry to moisture content not to exceed 19% after treatment.

D. Brush end cuts and drilled holes on job with two coats preservative used in the treatment.

PART 3 EXECUTION

3.1 LOCATIONS

A. All lumber and plywood in contact with concrete or masonry is to be treated wood.

END OF SECTION

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SECTION 07 11 13
BITUMINOUS DAMP PROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes cold-applied, emulsified asphalt damp proofing applied to the following surfaces:

1. Exterior, below-grade surfaces of concrete foundation walls.

2. Back side of concrete retaining walls, below grade.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates: For each product, signed by manufacturers.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary damp proofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt damp proofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of damp proofing in enclosed spaces. Maintain ventilation until damp proofing has thoroughly cured.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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: Retain above for nonproprietary or below for semi proprietary specification. Refer to Section 01 60 00 – Product Requirements.

1. Cold-Applied, Emulsified-Asphalt Damp proofing:

    a. Karnak Corporation.

    b. Koppers Industries, Inc.

    c. Meadows, W. R., Inc.

    d. Sonneborn, Div. of ChemRex, Inc.

    e. Tamms Industries.

2. Protection Course, Asphalt-Board Type:

    a. Grace, W. R. & Co.; Construction Products Div.

    b. Meadows, W. R., Inc.

    c. Sonneborn, Div. of ChemRex, Inc.

2.2 BITUMINOUS DAMPPROOFING

A. Odor Elimination: For interior and concealed-in-wall uses other than exterior face of inner wythe of cavity walls, provide damp proofing material warranted by manufacturer to be substantially odor free after drying for 24 hours under normal conditions.

B. Cold-Applied, Emulsified-Asphalt Damp proofing:

1. Trowel Coats: ASTM International (ASTM) D 1227, Type II, Class 1.

2. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

3. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.3 MISCELLANEOUS MATERIALS

A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

C. Protection Course, Asphalt-Board Type: Premolded, 1/8-inch- (3-mm-) thick, multi-ply, semirigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt and faced on one side with polyethylene film. Paragraph below describes Dow Chemical Company's "Protection Board" and "Protection Board II," Owens Corning's "Fan Fold," and Tenneco Building Products' "Amocor-PB4."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Begin damp proofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with damp proofing. Prevent damp proofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of damp proofing.

1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.

2. Allow each coat of damp proofing to cure 24 hours before applying subsequent coats.

B. Apply damp proofing to footings and foundation walls whether indicated or not.

1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of six inches (150 mm) over outside face of footing.

2. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of damp proofing. Damp proofing coat required for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. On Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gallons/100 square feet (0.6 L/m^2) for first coat and 1 gallon/100 square feet (0.4 L/m^2) for second coat, one fibered brush or spray coat at not less than 3 gallons/100 square feet (1.2 L/m^2), or one trowel coat at not less than 4 gallons/100 square feet (1.6 L/m^2).

B. On Backs of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gallons/100 square feet (0.5 L/m^2).

3.5 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured damp proofing. Comply with damp proofing material manufacturer's written recommendations for attaching protection course. Support protection course with spot application of trowel-grade mastic where not otherwise indicated.

3.6 CLEANING

A. Remove damp proofing materials from surfaces not intended to receive damp proofing.

END OF SECTION

SECTION 07 19 00
WATER REPELLENTS (MASONRY)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes clear water-repellent coatings for the following vertical and nontraffic horizontal surfaces:

1. Concrete unit masonry (unpainted and unglazed).

B. Related Sections include the following:

1. Division 3 Sections for concrete work including floor sealers and curing agents.
2. Division 4 Sections for concrete unit masonry.
3. Section 07 92 00 – Joint Sealants – Architectural for joint sealants.
4. Section 09 90 00 – Protective Coatings for paints and coatings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.

1. Absorption: Minimum 98 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
    a. Concrete Unit Masonry: ASTM International (ASTM) C 140.
2. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
3. Water Penetration and Leakage through Masonry: Maximum 98 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
4. Durability: Maximum five percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 53.
5. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D 1653.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

B. Samples: Of each substrate indicated to receive water repellent, 12 inches square, with specified repellent treatment applied to half of each sample.

C. Applicator Certificates: Signed by manufacturer certifying that the applicator complies with requirements.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who employs only persons trained and approved by water repellent manufacturer for application of manufacturer's products.

1.6 TEST PANELS

A. Field Samples: Select multiple representative surfaces for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed and in accordance with provisions in this Section. Comply with application requirements of this Section.

1. Obtain Architect's approval of field samples before applying water repellents.
2. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.

B. Clean test panel area following substrate manufacture’s guidelines and recommended products for cleaning.

C. After substrate has dried, RILEM tube testing shall be done by manufactures representative, to determine coverage rates.

D. Before full-scale application, review manufacturer's product data sheets to determine the suitability of each product for the specific surfaces. Apply each water repellent to test panels to determine number of applications, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.

E. Apply water repellents to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results. A final RILEM tube test shall be done to determine if desired finish has been accomplished. Do not begin full-scale application until test panels are inspected and approved by the Architect and the Manufacturer.

F. Test Panel Requirements:

1. Size: Minimum four feet by four feet each.

2. Locations: As determined by the Architect.

3. Number: As required to completely test each water repellent with each type of substrate to be protected.

1.7 PROJECT CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:

1. Ambient temperature is less than 40˚F.

2. Concrete surfaces and mortar have cured for less than 28 days.

3. Rain or temperatures below 40˚F are predicted within 24 hours.

4. Application is earlier than 24 hours after surfaces have been wet.

5. Substrate is frozen or surface temperature is less than 40˚F.

6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.

1.8 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 inch (1.5 mm) wide, fire, vandalism, or abuse by maintenance equipment.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

i) Blok-Guard & Graffiti Control VOC 9. Or approved equal by architect.

2.2 WATER REPELLENTS

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Water and Graffiti- Resistant Treatment:

(1) Use clear-drying, penetrating, solvent-based silicone for weatherproofing masonry materials and protecting them from graffiti.

(2) Physical and Performance Properties:

(a) Total Solids per ASTM D 2369: Nine (9) percent.

(b) Comply with national, state, and district AIM VOC regulations.

(c) Water Absorption Reduction (Brick) per ASTM C 67: Greater than 96 percent.

(d) Water Absorption Reduction per ASTM C 140:

(i) Heavy Weight CMU: Greater than 89 percent.

(ii) Split Face CMU: Greater than 95 percent.

(e) Water Vapor Transmission per ASTM E96:

(i) Limestone: Greater than 86 percent.

(ii) Sandstone: Greater than 95 percent.

(iii) Concrete Block: Greater than 95 percent.

(iv) Mortar: Greater than 95 percent.

(f) Water Vapor Transmission WVT per ASTM D 6490: Minimum 88 percent retention.

(g) Cleanability Level 2 per ASTM D7089.

(3) Approved Products:

(a) "Sure Klean Weather Seal Blok-Guard & Graffiti Control VOC 9"; PROSOCO, Inc. (800-255-4255) (Basis of Design). Or approved equal by architect.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.

B. Test for pH level, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

E. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location that has been fully cleaned and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.

1. Revisions of planned application, if any, as requested by Architect, will be by Change Order if they constitute a departure from requirements of Contract Documents at the time of contracting.

3.2 APPLICATION

A. Application rate shall be in accordance with manufacturer’s written recommendations and in accordance with proper coverage rates for warranty requirements.

B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.

1. Precast Work: At Contractor's option, first application of water repellent on precast concrete units may be completed before installing units. Mask sealant-bond surfaces to prevent water repellent from migrating onto joint surfaces.

C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and

after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

3.4 CLEANING

A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.

B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

3.5 EXTERIOR SCHEDULE

A. General: Provide the following systems for the various substrates, as indicated.

1. MASONRY SEALER (Concrete Masonry Units)

a. 1st Coat: ProSoCo Sure Klean Weather Seal Blok-Guard and Graffiti Control.

b. Apply one (1) uniform pinhole free, continuous flood coat from the bottom up, with a 6-8-inch run-down, at rate of 75-100 square feet per gallon and in accordance with test application coverage rate. Test application rate shall govern where a discrepancy occurs.

c. Apply 2nd coat within two hours of the first coat or as soon as the first coat is dry to touch.

END OF SECTION

SECTION 07 21 00

INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Foundation wall insulation (supporting backfill).
   2. Concealed building insulation.
   3. Interior rigid insulation
   4. Radiant barriers.
   5. Safing insulation.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 7 Section "Metal Roof Panels" and “PVC Membrane Roofing” for insulation specified as part of roofing construction.
   2. Division 9 Section indicated below for insulation installed as part of metal-framed wall and partition assemblies:
      a. "Gypsum Board Assemblies."

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of insulation product specified.

C. Product test reports from and based on tests performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this

Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:
   1. Extruded-Polystyrene Board Insulation:
      a. Amoco Foam Products Company.
      b. Carlisle Company.
      c. Dow Chemical Co.
      d. UC Industries, Inc.; Owens-Corning Co.
   2. Polyisocyanurate Foil faced Board insulation
      a. Johns Manville
      b. Dow Chemical Co.
      c. Hunter Panels
   3. Glass-Fiber Insulation:
      a. CertainTeed Corporation.
      b. Knauf Fiber Glass GmbH.
      c. Owens-Corning Fiberglas Corporation.
      d. Johns Manville Corporation.

2.02 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.
   1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

B. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process to comply with ASTM C 578 for type and with other requirements indicated below:
   1. Type IV, 1.60-lb/cu. ft. (26-kg/cu. m) minimum density, unless otherwise indicated.
   2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.
   3. Recycled Content: Not less than 50 percent blend of postconsumer and recovered polystyrene resins.

C. Interior wall insulation: R-13 (2”) Hunter Panels XCI 286 with foil facer both sides. Polyisocyanurate Board Insulation, Glass-Fiber-Mat Faced ASTM C1289, glass-fiber-mat faced, Type 1, Class 1.
   1. Where insulation is exposed use the following accessories:
      a. Anchor to wall with “Plasti-Grip” PMF anchors spacing per MFR recommendations
      b. Exposed edges provide J-Channel closure, class-A rated, white, Mfr: Victory Bear. Anchor to wall with power-actuated fasteners per Mfr. recommendations.
      c. Panel edge connector provide Flex-Tite insulation clips, class-A rated, white, Mfr: Victory Bear. Anchor to wall with power-actuated fasteners per Mfr. recommendations.

D. Unfaced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).
   1. Mineral-Fiber Type: Fibers manufactured from glass.
   2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

E. Faced Mineral-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame spread of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on one face; consisting of fibers manufactured from glass.

F. Sound Attenuation Blankets: ASTM C 665, Type I; semi-rigid mineral fiber blanket without membrane, Class 25 flame-spread. Furnish in 2-3/4", 4" and 6" thicknesses. Provide minimum thickness as required to achieve a minimum 50 STC in all walls.

2.03 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

A. Polyisocyanurate Board Insulation, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

1 Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

2.04 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. BASF Corporation.
   b. Dow Chemical Company (The).
   c. Gaco Western Inc.
   d. Henry Company.
   e. SWD Urethane Company.
2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).
3. Provide IBC approved Intumescent coating: DC315 Manufactured by International Fireproof Technology, Inc, or Fireshell TB Manufactured by TPR2 Corporation or approved equal by architect.

2.05 SAFING INSULATION AND ACCESSORIES

A. Slag-Wool-Fiber Board Safing Insulation: Semirigid boards designed for use as fire stop at openings between edge of slab and exterior wall panels, produced by combining slag-wool fibers with thermosetting resin binders to comply with ASTM C 612, Type IA and IB; nominal density of 4 lb/cu. ft. (64 kg/cu. m); passing ASTM E 136 for combustion characteristics; thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

B. Calking Compound: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.

C. Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.

2.06 VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft. (12 kg/100 sq. m), with maximum permeance rating of 0.0507 perm (2.9 ng/Pa x s x sq. m).

B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Reinforced-Polyethylene Vapor Retarders:
      a. DURA-SKRIM 6WW; Raven Industries, Inc.
      b. Griffolyn T-65; Reef Industries, Inc., Griffolyn Div.

2.07 EXTERIOR AIR BARRIER

A. NOT USED

2.08 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

2.09 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation, of thickness indicated, securely in position indicated with self-locking washer in place; and complying with the following requirements:
   1. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
   2. Spindle: Copper-coated low carbon steel, fully annealed, 0.105 inches (2.67 mm) in diameter, length to suit depth of insulation indicated.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
   1. Where spindles will be exposed to human contact after installation, protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

D. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Adhesively Attached, Spindle-Type Anchors:
      a. TACTOO Insul-Hangers; AGM Industries, Inc.
      b. Spindle Type Gemco Hangers; Gemco.
   2. Anchor Adhesives:
      a. TACTOO Adhesive; AGM Industries, Inc.
      b. Tuff Bond Hanger Adhesive; Gemco.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

3.03 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.04 INSTALLATION OF PERIMETER INSULATION

A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to written instructions of insulation manufacturer.

3.05 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
   1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
   1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
   2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.06 INSTALLATION OF SAFING INSULATION

A. Install safing insulation to fill gap between edge of concrete floor slab and back of exterior spandrel panels on safing clips spaced as needed to support insulation, but not further apart than 24 inches (610 mm) on center (o.c.). Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of slab with calking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

3.07 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than 2 wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches (406 mm) on center (o.c.).

C. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

F. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.08 PROTECTION

A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 41 10

METAL ROOF PANELS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Factory-formed and field-assembled, standing-seam metal roof panels.
   2. Metal soffit panels.

B. Related Sections include the following:
   1. Division 7 Section "Sheet Metal Flashing and Trim" for flashings and other sheet metal work not part of metal roof panel assemblies.
   2. Division 7 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.03 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.

1.04 PERFORMANCE REQUIREMENTS

A. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers' standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.

B. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 283.

C. Water Penetration: No water penetration when tested according to ASTM E 331.

D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift resistance class indicated.

E. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
   1. Fire/Windstorm Classification: Class 1A-90.

2. Hail Resistance: SH.

F. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
   1. Wind Loads: Determine loads based on the following minimum design wind pressures:
      a. Uniform pressure as indicated on Structural drawings.

G. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.05 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory- and field-assembled work.
   1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
      a. Flashing and trim.
      b. Gutters.
      c. Downspouts.
      d. Roof curbs.
      e. Snow guards.

C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:
   1. Roof panels and attachments.
   2. Roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, snow guards, and items mounted on roof curbs.

D. Samples for Selection: For each type of metal roof panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.

E. Qualification Data: For Installer.

F. Maintenance Data: For metal roof panels to include in maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
   1. Installer's responsibilities include fabricating and installing metal roof panel assemblies.

B. Source Limitations: Obtain each type of metal roof panels through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Surface-Burning Characteristics: Provide insulation material with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Flame-Spread Index: 25 or less, unless otherwise indicated.
   2. Smoke-Developed Index: 450 or less, unless otherwise indicated.

E. Preliminary Roofing Conference: Before starting roof sheathing construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 1 Section. Review methods and procedures related to roof sheathing construction and metal roof panels including, but not limited to, the following:
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, sheathing Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
   2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
   4. Examine sheathing conditions for compliance with requirements, including flatness and attachment to structural members.
   5. Review structural loading limitations of sheathing during and after roofing.
   6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
   7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
   8. Review temporary protection requirements for metal roof panels during and after installation.
   9. Review roof observation and repair procedures after metal roof panel installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

E. Protect foam-plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.08 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal roof panels without field measurements, or allow for field-trimming of panels. Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.09 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

B. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
   1. Weathertight Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
   2. 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 PANEL MATERIALS

A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
   2. Surface: Smooth, flat finish.
   3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings.
      a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
         1) Fluoropolymer Three-Coat System: Manufacturer's standard three-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, with a minimum total dry film thickness of 1.5 mil (0.038 mm);

complying with physical properties and coating performance requirements of AAMA 2605, except as modified below:

a) Humidity Resistance: 2000 hours.

b) Water Resistance: 2000 hours.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.

2.03 THERMAL INSULATION FOR FIELD-ASSEMBLED METAL ROOF PANELS

A. Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type V, oriented-strand-board facing, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core. With cross vent 1.5” air space to provide cold-roof system (“Cool-Vent” Cross vent system or approved equal). Mechanically attached to deck.

2.04 UNDERLAYMENT MATERIALS

A. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felts.

B. Self-Adhering, Polyethylene-Faced Sheet: ASTM D 1970, 40 mils thick minimum, consisting of slip-resisting polyethylene-film reinforcing and top surface laminated to SBS-modified asphalt adhesive, with release-paper backing; cold applied.

1. Available Products:
   a. Carlisle Coatings & Waterproofing, Div. of Carlisle Companies Inc.; Dri-Start "A."
   b. Grace, W. R. & Co.; Grace Ice and Water Shield.
   c. Johns Manville International, Inc.; Roof Defender.
   d. Owens Corning; WeatherLock.
   e. Protecto Wrap Company; Rainproof TM.

C. Slip Sheet: Building paper, minimum 5 lb/100 sq. ft., rosin sized.

D. Vapor barrier (Carlisle CCW705 or approved equal.).

2.05 MISCELLANEOUS MATERIALS

A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.
   1. Fasteners for Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
   2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
   3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.06 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
   1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together.
   1. Basis-of-Design Product: MBCI , Super-Lock 16” wide Panel or a comparable product of one of the following:
   2. Available Manufacturers:
      a. AEP-Span.
      b. BHP Steel Building Products USA Inc.
      c. CENTRIA Architectural Systems.
      d. MBCI; Div. of NCI Building Systems.
   3. Material: Zinc-coated (galvanized) steel sheet, 0.0269 inch thick.
      a. Exterior Finish: Fluoropolymer.
      b. Color: As selected by Architect from manufacturer's full range.
   4. Batten: Same material, finish, and color as roof panels.
   5. Clips: Floating to accommodate thermal movement.
      a. Material: 0.0528-inch- (1.35-mm-) thick, zinc-coated (galvanized) steel sheet.

6. Joint Type: Single folded.
7. Weatherseal: Provide factory applied extruded vinyl weatherseal.
8. Panel Coverage: 16 inches (406 mm).
9. Panel Height: 2.0 inches (51 mm).
10. Uplift Rating: UL 90.

2.07 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and flat pan between panel edges; with flush joint between panels.
   1. Basis-of-Design Product: MBCI Artisan Series, Flush Seam Panel or a comparable product of one of the following:Available Manufacturers:
      a. AEP-Span.
      b. BHP Steel Building Products USA Inc.
      c. CENTRIA Architectural Systems.
      d. MBCI; Div. of NCI Building Systems.
   3. Material: Zinc-coated (galvanized) steel sheet, 0.0269 inch (0.70 mm) thick.
      a. Exterior Finish: Fluoropolymer.
      b. Color: As selected by Architect from manufacturer's full range.
   4. Panel Coverage: 3-7/8 inches (98.33 mm).
   5. Panel Height: 0.500 inch (13 mm)Sealant: Factory applied within interlocking joint.

2.08 ACCESSORIES

A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
   1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
   2. Clips: Minimum 0.0625-inch- (1.6-mm-) thick, stainless-steel panel clips designed to withstand negative-load requirements.
   3. Cleats: Mechanically seamed cleats formed from minimum 0.0250-inch- (0.64-mm-) thick, stainless-steel or nylon-coated aluminum sheet.
   4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure

strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.0179-inch thick, zinc-coated (galvanized) steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

C. Gutters: Formed from 0.0179-inch thick, zinc-coated (galvanized) steel sheet prepainted with coil coating. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced 36 inches (900 mm) o.c., fabricated from same metal as gutters. Provide bronze, copper, or aluminum wire ball strainers at outlets. Finish gutters to match roof fascia and rake trim.

D. Downspouts: Formed from 0.0179-inch thick, zinc-coated (galvanized) steel sheet prepainted with coil coating; in 10-foot long sections, complete with formed elbows and offsets. Finish downspouts to match metal roof panels.

E. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring.

1. Seam-Mounted, Stop-Type Snow Guards: Cast-aluminum stops designed for attachment to vertical ribs of standing-seam metal roof panels with stainless-steel set screws.
    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    b. TRA Snow & Sun. Clamp to seam snow fence. Or approved equal. Color to match roof.
        1) Berger Bros. Co.
        2) Polar Blox.

F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.09 FABRICATION

A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.

1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

C. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written recommendations.

3.03 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL ROOF PANELS

A. Board Insulation: Extend insulation in thickness indicated to cover entire roof. Comply with installation requirements in Division 7 Section "Building Insulation."

1. Erect insulation horizontally and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c. Securely attach narrow flanges of furring members to roof deck with screws spaced 24 inches (600 mm) o.c.

3.04 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment and building-paper slip sheet on roof sheathing under metal roof panels, unless otherwise recommended by metal roof panel manufacturer. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels. Apply at locations indicated below, in shingle fashion to shed water, with lapped joints of not less than 2 inches.

1. Apply on roof not covered by self-adhering sheet underlayment. Lap edges of self-adhering sheet underlayment not less than 3 inches (75 mm), in shingle fashion to shed water.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on roof sheathing under metal roof panels. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply at locations indicated below, in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Roof perimeter for a distance up from eaves of 24 inches (600 mm) beyond interior wall line.
2. Valleys, from lowest point to highest point, for a distance on each side of 18 inches (460 mm). Overlap ends of sheets not less than 6 inches (150 mm).
3. Rake edges for a distance of 18 inches (460 mm).
4. Hips and ridges for a distance on each side of 12 inches (300 mm).
5. Roof to wall intersections for a distance from wall of 18 inches (460 mm).

6. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches (460 mm).

C. Install flashings to cover underlayment to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."

D. Apply slip sheet over underlayment before installing metal roof panels.

3.05 METAL ROOF PANEL INSTALLATION, GENERAL

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Field cutting of metal roof panels by torch is not permitted.
   2. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels.
   3. Provide metal closures at peaks, rake edges, each side of ridge and hip caps.
   4. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
   5. Locate and space fastenings in uniform vertical and horizontal alignment.
   6. Install ridge and hip caps as metal roof panel work proceeds.
   7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:
   1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.
   1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.
   2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.06 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
   1. Install clips to supports with self-tapping fasteners.
   2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
   3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.07 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
   1. Provide elbows at base of downspouts to direct water away from building.

E. Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with clamps or set screws. Do not use fasteners that will penetrate metal roof panels.

1. Install snow guards above entrances, adjacent to walking surfaces, at other areas where falling snow may be hazardous and at locations as recommended by the manufacturer and where directed by the Architect. Install in accordance with manufacturer=s printed instructions and recommendations.

F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.08 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.09 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 62 10
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sheet metal flashing and trim:

1. Manufactured reglets.
2. Formed roof drainage system.
3. Formed low-slope roof flashing and trim.
4. Formed wall flashing and trim.
5. Formed equipment support flashing.

B. Related Sections include the following:

1. Section 04 30 00 – Unit Masonry for installing through-wall flashing, reglets, and other sheet metal flashing and trim.
2. Section 07 54 19 – PVC Membrane Roofing for flashing and trim not part of sheet metal flashing and trim.
3. Section 07 92 00 – Joint Sealants – Architectural for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FM Global (FMG) Loss Prevention Data Sheet 1-49:

1. Wind Zone 1: For velocity pressures of 21- to 30-pound force per square foot (1.00 to 1.44 kPa): 60-pound force per square foot (2.87-kPa) perimeter uplift force, 90-pound force per square foot (4.31-kPa) corner uplift force, and 30-pound force per square foot (1.44-kPa) outward force.

C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and

surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120°F (67°C), ambient; 180°F (100°C), material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Samples for Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

1.5 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with Sheet Metal and Air Conditioning Contractors' National Association’s (SMACNA’s) "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Mockups: Prior to installing sheet metal flashing and trim, construct mockups indicated to verify selections made under Sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.

2. Notify Architect one week in advance of the dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Construct mockups for the following type of sheet metal flashing and trim:

   a. Exposed trim, gravel stops, and fasciae.

   b. Copings.

5. Obtain Architect's approval of mockups before start of final unit of Work.

6. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

   a. When directed, demolish and remove mockups from Project site.

   b. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Engineer, Architect, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.

2. Review methods and procedures related to sheet metal flashing and trim.

3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.

4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.8 FM GLOBAL REQUIREMENTS (NOT USED)

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 SHEET METALS

A. Aluminum Sheet: ASTM International (ASTM) B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Alclad Finish: Metallurgically bonded surfacing to both sides, forming a composite aluminum sheet with reflective luster.

2. Surface: Smooth, flat.

3. Factory Prime Coating: Where painting after installation is indicated, pretreat with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil (0.005 mm).

4. Clear Anodic Finish, Coil Coated: American Architectural Manufacturers Association (AAMA) 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

5. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

a. Color: Clear Anodized

b. Color Range: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

6. Exposed Coil-Coated Finishes:

a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

7. Color: As selected by Architect from manufacturer's full range.

8. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. Slip Sheet: Rosin-sized paper, minimum three pounds per 100 squre feet (0.16 kg/m^2).

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
4. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

C. Solder for Lead: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Solder for Zinc: ASTM B 32, 60 percent lead and 40 percent tin with low antimony, as recommended by manufacturer.

E. Burning Rod for Lead: Same composition as lead sheet.

F. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

G. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

I. Bituminous Coating: Cold-applied asphalt mastic, The Society for Protective Coatings (SSPC)-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory- mitered and -welded corners and junctions.

1. Available Manufacturers:

a. Fry Reglet Corporation.

2. Material: Aluminum, 0.024 inch (0.61 mm) thick.

3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

a. Available Manufacturers:

i. Cheney Flashing Company, Inc., Type B Snap Lock.

5. Flexible Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.

6. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Seams: Comply with SMACNA Architectural Sheet Metal Manual, (Sixth Edition, September 2003) Figure no. 3-2 and 3-3 as applicable to specific installations.

1. Standing Seams: Provide double lock standing seams (detail no. 25, figure no. 3-3), with finish not less than 1-1/4-inch high.

F. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than one inch (25 mm) deep, filled with elastomeric sealant concealed within joints.

G. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

H. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.7 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.

1. Gutter Style: D and as detailed.

2. Expansion Joints: Built in.

3. Accessories: Continuous removable leaf screen with sheet metal frame and hardware cloth screen.

4. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following material:

a. Pre-finished Aluminum: 0.032 inch (0.81 mm).

B. Downspouts: Fabricate rectangular downspouts complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Fabricate downspouts from the following material:

a. Pre-finished Aluminum: 0.040 inch (1.02 mm).

2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot (3-m) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style: Standing seams.

2. Fabricate copings from the following material:

a. Pre-finished Aluminum: 0.050 inch (1.27 mm).

B. Roof and Roof to Wall Transition Expansion-Joint Cover: Fabricate from the following material:

1. Pre-finished Aluminum: 0.050 inch (1.27 mm).

C. Base Flashing: Fabricate from the following material:

1. Pre-finished Aluminum: 0.040 inch (1.02 mm).

D. Counterflashing: Fabricate from the following material:

1. Aluminum: 0.032 inch (0.81 mm).

E. Flashing Receivers: Fabricate from the following material:

1. Aluminum: 0.032 inch (0.81 mm).

F. Roof-Penetration Flashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm).

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch (2400-mm) long, but not exceeding 12 foot (3.6 m) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend six inches (150 mm) beyond each side of wall openings. Form with 2-inch (50-mm) high end dams. Fabricate from the following material:

1. Stainless Steel: 0.016 inch (0.40 mm).

B. Openings Flashing in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend four inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch (50-mm) high end dams. Fabricate from the following material:

1. Pre-finished Aluminum: 0.032 inch (0.81 mm).

C. Wall Expansion-Joint Cover: Fabricate from the following material:

1. Pre-finished Aluminum: 0.040 inch (1.02 mm).

2.10 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following material:

1. Stainless Steel: 0.019 inch (0.48 mm).

2.11 FINISHES

A. Comply with National Association of Architectural Metal Manufacturer's (NAAMM's) "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Coat side of sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.

3. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than one inch (25 mm) deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

1. Use stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than one inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40° and 70°F (4° and 21°C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40°F (4°C).

2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 – Joint Sealants – Architectural.

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.

1. Do not solder prepainted, metallic-coated steel sheet.

2. Pretinning is not required for lead.

3. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.

4. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with elastomeric sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches (900 mm) apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.

2. Loosely lock straps to front gutter bead and anchor to roof deck.

3. Anchor and loosely lock back edge of gutter to continuous eave or apron flashing.

4. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches (600 mm) apart.

5. Anchor gutter with spikes and ferrules spaced not more than 24 inches (600 mm) apart.

6. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.24 m) apart. Install expansion joint caps.

7. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints. Provide fasteners designed to hold downspouts securely one inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.

1. Provide elbows at base of downspout to direct water away from building or connect downspouts to underground drainage system indicated.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 16-inch (400-mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleats anchored to substrate at 16-inch (400-mm) centers.

2. Anchor interior leg of coping with screw fasteners and washers at 18-inch (450-mm) centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of four inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing four inches (100 mm) over base flashing. Lap counterflashing joints a minimum of four inches (100 mm) and bed with elastomeric sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of formed through-wall flashing is specified in Section 04 30 00 – Reinforced Unit Masonry.

C. Reglets: Installation of reglets is specified in Section 03 30 00 – Cast-in-Place Concrete and in Section 04 30 00 – Reinforced Unit Masonry.

D. Openings Flashing in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend four inches (100 mm) beyond wall openings.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

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SECTION 07 92 00

JOINT SEALANTS - ARCHITECTURAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:
   1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry and cast stone units.
      c. Joints between metal panels.
      d. Joints between different materials listed above.
      e. Perimeter joints between materials listed above and frames of doors and windows.
      f. Control and expansion joints in ceilings and other overhead surfaces.
      g. Other joints as indicated.
   2. Exterior joints in the following horizontal traffic surfaces:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Tile control and expansion joints.
      c. Joints between different materials listed above.
      d. Other joints as indicated.
   3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of walls and partitions.
      e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
      f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      g. Other joints as indicated.
   4. Interior joints in the following horizontal traffic surfaces:
      a. Isolation joints in cast-in-place concrete slabs.
      b. Control and expansion joints in tile flooring.
      c. Other joints as indicated.

B. Related Sections include the following:

1. Division 4 Section “Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 8 Section "Glazing" for glazing sealants.
3. Division 9 Section "Gypsum Board" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
4. Division 9 Section "Ceramic Tile" for sealing tile joints.
5. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.03 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

F. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

H. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
   3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
   5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:
   1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
   2. Conduct field tests for each application indicated below:
      a. Each type of elastomeric sealant and joint substrate indicated.
      b. Each type of nonelastomeric sealant and joint substrate indicated.
   3. Notify Architect seven days in advance of dates and times when test joints will be erected.
   4. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   5. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
   6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

E. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Three years from date of Substantial Completion.

B. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
   1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and

application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Single-Component Neutral-Curing Silicone Sealant:
   1. Available Products:
      a. Pecora Corporation; 895.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 50.
   4. Use Related to Exposure: NT (nontraffic).
   5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
      a. Use O Joint Substrates: Aluminum coated with a high-performance coating.
   6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

F. Single-Component Acid-Curing Silicone Sealant:
   1. Available Products:
      a. Dow Corning Corporation; 999-A.
      b. GE Silicones; Construction
      c. Pecora Corporation; 860.
      d. Tremco; Proglaze.
   2. Type and Grade: S (single component) and NS (nonsag).
   3. Class: 25.

4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
    a. Use O Joint Substrates: Aluminum coated with a high-performance coating.

G. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:
1. Available Products:
    a. Pecora Corporation; 898.
    b. Tremco; Tremsil 600 White.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
    a. Use O Joint Substrates: Ceramic tile.

H. Multicomponent Nonsag Urethane Sealant:
1. Available Products:
    a. Pecora Corporation; Dynatrol II.
    b. Tremco; Dymeric 511.
2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
    a. Use O Joint Substrates: Aluminum coated with a high-performance coating.

I. Multicomponent Pourable Urethane Sealant:
1. Available Products:
    a. Pecora Corporation; Dynatrol II-SG.
    b. Sika Corporation, Inc.; Sikaflex - 2c SL.
    c. Sonneborn, Division of ChemRex Inc.; SL 2.
2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

J. Single-Component Nonsag Urethane Sealant:
1. Available Products:
    a. Pecora Corporation; Dynatrol I-XL.
    b. Sika Corporation, Inc.; Sikaflex - 15LM.

c. Tremco; DyMonic.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

2.04 SOLVENT-RELEASE JOINT SEALANTS

A. Acrylic-Based Solvent-Release Joint Sealant: Comply with ASTM C 1311 or FS TT-S-00230.
   1. Available Products:
      a. Tremco; Mono 555.

B. Butyl-Rubber-Based Solvent-Release Joint Sealant: Comply with ASTM C 1085.
   1. Available Products:
      a. Sonneborn, Division of ChemRex Inc.; Sonneborn Multi-Purpose Sealant.
      b. Tremco; Tremco Butyl Sealant.

2.05 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:
   1. Pecora Corporation; AC-20+.
   2. Sonneborn, Division of ChemRex Inc.; Sonolac.
   3. Tremco; Tremflex 834.

2.06 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:
   1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   2. Available Products:
      a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
      b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2.07 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.08 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    a. Metal.
    b. Glass.
    c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.04 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior vertical construction joints in cast-in-place concrete.
   1. Joint Sealant: Multicomponent nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

B. Joint-Sealant Application: Exterior horizontal nontraffic and traffic isolation and contraction joints in cast-in-place concrete slabs.
   1. Joint Sealant: Multicomponent pourable urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.

1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

D. Joint-Sealant Application: Exterior butt joints between metal panels.
1. Joint Sealant: Single-component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

E. Joint-Sealant Application: Exterior vertical joints between different materials listed above.
1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

F. Joint-Sealant Application: Exterior perimeter joints between unit masonry and frames of doors and windows.
1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

G. Joint-Sealant Application: Exterior control and expansion joints in ceilings and other overhead surfaces.
1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

H. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.
1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

I. Joint-Sealant Application: Interior perimeter joints of exterior openings.
1. Joint Sealant: Multicomponent nonsag urethane sealant or Single-component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

J. Joint-Sealant Application: Interior ceramic tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.
1. Joint Sealant: Multicomponent nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

K. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
1. Joint Sealant: Single-component mildew-resistant neutral-curing silicone sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

L. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry walls and partitions.
   1. Joint Sealant: Single-component nonsag urethane sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

M. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
   1. Joint Sealant: Latex sealant.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION

SECTION 07 92 13
SEALANTS AND CAULKING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

A. The Contractor shall furnish and install all caulking, sealing, moisture protection and appurtenant work, complete, all in accordance with the requirements of the Contract Documents. This section specifies sealants for general Construction and sealants that shall be in contact with waste material and water.

1.2 SUBMITTALS

A. Submittals shall conform to the provisions of Section 01 33 00 of the Specifications and shall include the following:

1. Manufacturer's product data showing conformance to the specified requirements.

2. Manufacturer's recommendations for storage, handling and application of sealants and primers.

3. Provide certified test reports from the sealant manufacturer indicating compliance with the requirements in Paragraph 2.2 below if required by the Engineer.

1.3 WARRANTY

A. The Contractor shall provide a 3-year written guarantee of the entire sealant installation against defects in materials and workmanship, together with a statement that he agrees to repair or replace, to the satisfaction of the Owner, at no additional cost to the Owner, any such defective areas which become evident within said 3-year guarantee period.

PART 2 PRODUCTS

2.1 GENERAL SEALANT

A. Sealant for all exterior arid interior building joint filling and sealing requirements shall be with General Electric Silicone 1300 Construction Sealant or approved equal.

2.2 ELASTOMERIC SEALANT

A. The sealant shall be an elastomeric polyurethane designed for bonding to concrete which is continuously submerged in wastewater. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of

hydraulic structures. Prior to ordering the sealant material, the Contractor shall submit to the Engineer for the Engineer's review sufficient data to show general compliance with the specification requirements. The material shall meet the following requirements:

1. Work Life 45 - 90 minutes

2. Time to reach 20 Shore "A" Hardness (@ 77°F, 200 gr. quantity) 24 hours, maximum

3. Ultimate Hardness 30 - 40 Shore "A"

4. Tensile Strength 100 psi, minimum

5. Ultimate Elongation 400 percent, minimum

6. Tear Resistance Die C ASTM D624) 75 pounds per inch of thickness, min.

7. Color Light Gray

B. Non-sag sealant shall be used on vertical exposed joints. Self-leveling sealant shall be used on horizontal exposed joints. Elastomeric polyurethane sealant shall be Sonolastic Polyurethane Sealant by Sonneborn or approved equal.

2.3 FILLER MATERIAL FOR SEALANT

A. Filler material shall be a non-gassing, resilient, closed-cell polyethylene foam and/or bond breaker of proper size for joint widths. It shall be compatible with sealant manufacturer's product.

2.4 PRIMERS

A. Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

2.5 SOLVENT WASH

A. Solvent wash for surface preparation and cleanup shall be as recommended in the manufacturer's printed instruction for caulking and sealants.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

A. Concrete shall have been cured 28 days. Thoroughly clean all joints, removing all concrete fins, dust, oil, grease, water, surface dirt and frost. Previously applied paint or primer must adhere permanently or be entirely removed.

B. Porous surfaces such as concrete shall be cleaned where necessary by grinding, sand or water blasting, abrading, acid washing, or combinations of these methods as required to provide a clean, sound base for sealant adhesion.

C. Non-porous surfaces such as metal shall be cleaned either mechanically or chemically. Protective coatings on metallic surfaces shall be removed by solvents such as xylene or toluene as specified herein. Solvent shall be used with clean, white cloths or lint-free paper towels. Do not allow solvent to air dry without wiping.

3.2 APPLICATION

A. Apply in accordance with manufacturer's printed instructions as to appropriate use. Sealants and caulking shall be applied with gun using nozzle of correct size for joint and shall be forced into grooves with sufficient pressure to expel air and completely fill the groove.

3.3 CLEANING

A. Clean all adjoining surfaces of excess sealants and caulking, smears or markings due to application and leave joint with neat, uniformly filled surface.

END OF SECTION

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SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

B. Section excludes:

1. Cabinets (casework), including locks in cabinets
2. Signage

C. Related Sections:

1. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
2. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
3. Division 26 “Electrical” sections for connections to electrical power system and for low-voltage wiring.

1.02 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 **SUBMITTALS**

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:

    a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
    b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
    c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

    a. Wiring Diagrams: For power, signal, and control wiring and including:
        1) Details of interface of electrified door hardware and building safety and security systems.
        2) Schematic diagram of systems that interface with electrified door hardware.
        3) Point-to-point wiring.
        4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule:

a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
c. Indicate complete designations of each item required for each opening, include:
    1) Door Index: door number, heading number, and Architect's hardware set number.
    2) Quantity, type, style, function, size, and finish of each hardware item.
    3) Name and manufacturer of each item.
    4) Fastenings and other pertinent information.
    5) Location of each hardware set cross-referenced to indications on Drawings.
    6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    7) Mounting locations for hardware.
    8) Door and frame sizes and materials.
    9) Degree of door swing and handing.
    10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule:

a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.

2. Provide Product Data:

    a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

    a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    b. Catalog pages for each product.
    c. Final approved hardware schedule edited to reflect conditions as installed.
    d. Final keying schedule
    e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
    f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:

    a. fire door assemblies, in compliance with NFPA 80.
    b. required egress door assemblies, in compliance with NFPA 101.

1.04 **QUALITY ASSURANCE**

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

    a. For door hardware: DHI certified AHC or DHC.

b. Can provide installation and technical data to Architect and other related subcontractors.
c. Can inspect and verify components are in working order upon completion of installation.
d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
b. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Smoke and Draft Control Door Assemblies:

a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.

3. Electrified Door Hardware

a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

4. Accessibility Requirements:

a. Comply with governing accessibility regulations cited in “REFERENCES” article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
2) Preliminary key system schematic diagram.

3) Requirements for key control system.
4) Requirements for access control.
5) Address for delivery of keys.

2. Pre-installation Conference

a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Inspect and discuss preparatory work performed by other trades.
c. Inspect and discuss electrical roughing-in for electrified door hardware.
d. Review sequence of operation for each type of electrified door hardware.
e. Review required testing, inspecting, and certifying procedures.
f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:

a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 **DELIVERY, STORAGE, AND HANDLING**

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer’s original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 **COORDINATION**

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.07 **WARRANTY**

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer’s published listings.

    a. Mechanical Warranty
        1) Locks
            a) Falcon: 10 year
        2) Exit Devices
            a) Falcon: 10 year
        3) Closers
            a) LCN 4050 Series: 25 year

1.08 **MAINTENANCE**

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 **HINGES**

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Ives 5BB series

2. Acceptable Manufacturers and Products:

    a. Hager BB1191/1279 series
    b. McKinney TB series
    c. Stanley FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

    a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
    b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

    a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:

    a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
9. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

a. Steel Hinges: Steel pins
b. Non-Ferrous Hinges: Stainless steel pins
c. Out-Swinging Exterior Doors: Non-removable pins
d. Out-Swinging Interior Lockable Doors: Non-removable pins
e. Interior Non-lockable Doors: Non-rising pins

10. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 **CONTINUOUS HINGES**

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Select
b. Stanley
c. Roton
d. ABH
e. Hager

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 **FLUSH BOLTS**

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Rockwood
c. DCI
d. Trimco
e. Don-Jo
f. Hager

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 **MORTISE LOCKS**

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

a. Falcon MA series

2. Acceptable Manufacturers and Products:

a. Corbin-Russwin ML2000 series
b. Sargent 8200 series
c. Yale 8800 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
3. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.

4. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
6. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide a request to exit (RX) switch that is actuated with rotation of inside lever.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.

    a. Lever Design: DANE

2.07 **EXIT DEVICES**

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. Falcon 24/25 series

2. Acceptable Manufacturers and Products:

    a. Sargent 19-43-GL-80 series
    b. Precision Apex series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer’s approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.

13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
    1) .

2.08 **KEYING**

A. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

    a. Master Keying system as directed by the Owner.

2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. Provide keys with the following features:

    a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    b. Patent Protection: Keys and blanks protected by one or more utility patent(s).
    c. Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.

4. Identification:

    a. Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    b. Identification stamping provisions must be approved by the Architect and Owner.
    c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
    d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
    e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

5. Quantity: Furnish in the following quantities.

    a. Change (Day) Keys: 3 per cylinder/core.
    b. Permanent Control Keys: 3.
    c. Master Keys: 6.

2.09 **KEY CONTROL SYSTEM**

A. Manufacturers:

1. Scheduled Manufacturer:

    a. Telkee

2. Acceptable Manufacturers:

    a. HPC
    b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.

    a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
    b. Provide hinged-panel type cabinet for wall mounting.

2.10 **DOOR CLOSERS**

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:

    a. LCN 4050A series

2. Acceptable Manufacturers and Products:

    a. Falcon SC70A series
    b. Norton 7500 series
    c. Sargent 351 series
    d. Yale 4400 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.

6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.11 **DOOR TRIM**

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Ives.

2. Acceptable Manufacturers:

   a. Elmes
   b. Trimco
   c. Burns
   d. Rockwood

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.12 **PROTECTION PLATES**

A. Manufacturers:

1. Scheduled Manufacturer:

   a. Ives

2. Acceptable Manufacturers:

   a. Burns
   b. Trimco
   c. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.13 **OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS**

A. Manufacturers:

1. Scheduled Manufacturers:

    a. Glynn-Johnson

2. Acceptable Manufacturers:

    a. Rixson
    b. Sargent
    c. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.14 **DOOR STOPS AND HOLDERS**

A. Manufacturers:

1. Scheduled Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

    a. Trimco
    b. Burns
    c. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.15 **THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING**

A. Manufacturers:

1. Scheduled Manufacturer:

    a. Zero International

2. Acceptable Manufacturers:

    a. National Guard
    b. Reese
    c. Legacy
    d. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.16 **SILENCERS**

A. Manufacturers:

1. Scheduled Manufacturer:

    a. Ives

2. Acceptable Manufacturers:

    a. Burns
    b. Rockwood
    c. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.17 **DOOR POSITION SWITCHES**

A. Manufacturers:

1. Scheduled Manufacturer:

    a. Schlage

2. Acceptable Manufacturers:

a. GE-Interlogix
b. Sargent

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.18 **COAT HOOKS**

A. Manufacturers:

1. Scheduled Manufacturer:

a. Ives

2. Acceptable Manufacturers:

a. Burns
b. Rockwood

B. Provide coat hooks as specified.

2.19 **FINISHES**

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 **EXAMINATION**

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly

construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **PREPARATION**

A. Where on-site modification of doors and frames is required:

1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
2. Field modify and prepare existing doors and frames for new hardware being installed.
3. When modifications are exposed to view, use concealed fasteners, when possible.
4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:

    a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
    b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
    c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 **INSTALLATION**

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

R. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 **ADJUSTING**

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.05 **CLEANING AND PROTECTION**

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.06 **DOOR HARDWARE SCHEDULE**

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets: Refer to drawings Door Schedule.

END OF SECTION

SECTION 09 25 00

GYPSUM BOARD

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.
   2. Exterior gypsum sheating.
   3. Tile backing panels.

B. Related Sections include the following:
   1. Division 5 Section "Cold-Formed Metal Framing" for load-bearing steel framing that supports gypsum board.
   2. Division 7 Section "Building Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
   3. Division 7 Section "Joint Sealants" for acoustical sealants installed in assemblies that incorporate gypsum board.
   4. Division 9 Section "Non-Load-Bearing Steel Framing" for non-structural framing and suspension systems that support gypsum board.
   5. Division 9 Section "Ceramic Tile" for cementitious backer units installed as substrates for ceramic tile.
   6. Division 9 painting Sections for primers applied to gypsum board surfaces.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim `

1.04 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

1.05 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.01 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.02 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. American Gypsum Co.
      b. BPB America Inc.
      c. G-P Gypsum.
      d. National Gypsum Company.
      e. PABCO Gypsum.
      f. USG Corporation.

B. Type X:
   1. Thickness: 5/8 inch (15.9 mm).

2. Long Edges: Tapered.

C. Special Type X: Having improved fire resistance over standard Type X, and complying with requirements of fire-resistance-rated assemblies indicated on Drawings.
   1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
   2. Long Edges: Tapered.
   3. Abuse Resistant Type X: Where indicated on drawings
   4. Thickness: 5/8 inch (15.9 mm).
   5. Long Edges: Tapered.

2.03 EXTERIOR GYPSUM SHEATHING

A. General: Complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. American Gypsum Co.
      b. BPB America Inc.
      c. G-P Gypsum.
      d. National Gypsum Company.
      e. PABCO Gypsum.
      f. USG Corporation.

B. Type X:
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

2.04 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board:
   1. Complying with ASTM C 1178/C 1178M.
      a. Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum.
   2. Core: 5/8 inch (15.9 mm), Type X.

2.05 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.

d. L-Bead: L-shaped; exposed long flange receives joint compound.
e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
f. Expansion (control) joint.
g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.06 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.07 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants."

E. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

F. Vapor Retarder: As specified in Division 7 Section "Building Insulation."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.

2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.03 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
1. Type X: Vertical surfaces, unless otherwise indicated.
2. Special Type X: Where required for specific fire-resistance-rated assembly indicated.

B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints 1 framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with

vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.04 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panel: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.05 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Bullnose Bead: Use at outside corners, unless otherwise indicated
2. Cornerbead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

E. Install corner beads at external corners. Provide metal trim to protect edge of gypsum board wherever gypsum board intersects a dissimilar material. Hold channel and >L= trim back from metal window and door frames 1/8 inch to allow for caulking.

3.06 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 3: Panels that are substrates for wall coverings and wall panels.
   4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 9 Sections.

E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.07 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.08 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation before installing gypsum board ceilings and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
   1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
   2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
      a. Installation of 80 percent of lighting fixtures, powered for operation.
      b. Installation, insulation, and leak and pressure testing of water piping systems.
      c. Installation of air-duct systems.
      d. Installation of air devices.
      e. Installation of mechanical system control-air tubing.
      f. Installation of ceiling support framing.

END OF SECTION

SECTION 09 90 00
HIGH PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and applying protective coatings of paint to all surfaces indicated on the Drawings or specified herein, including all surface preparation and related work.

B. Not all coating systems in this specification will be used on this project.

1.2 EXCLUSIONS

A. Painting is not required for the following surfaces or items unless otherwise shown on the Drawings, specified in other sections, or specified herein:

1. Stainless steel, aluminum (except where in contact with concrete), chrome, fiberglass, copper instruments, pressure gauge tubing, and structural FRP. (unless noted on plans or finish schedules.)

2. Electrical panels, motor control centers, pumps, and motors having a factory finish. The factory finish shall be approved by the Engineer. Non-approved factory finishes shall be painted as specified hereinafter.

3. Surfaces hidden from view such as piping, ducts, structural wood, and insulation.

1.3 ABBREVIATIONS

A. CSM - Coating System Manufacturer.

B. CSA - Coating System Applicator. Specialty subcontractor retained by the Contractor to install the coating systems specified in this Section.

C. CTR - Coating System Manufacturer's Technical Representative.

1.4 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American National Standards Institute (ANSI)

a. Standard Colors for Color Identification and Coding

b. A13.1, Scheme for the Identification of Piping Systems

2. American Water Works Association (AWWA)

a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot-Applied

b. C210, Liquid Epoxy Coating System for the Interior and Exterior of Steel Water Pipelines

c. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines

3. NSF International (NSF): 61 Drinking Water System Components-Health Effects

4. National Association of Corrosion Engineers (NACE): Manual for Painter Safety

5. Occupational Safety and Health Act (OSHA)

6. Steel Structures Painting Council (SSPC)

a. QP1, Standard Procedure for Evaluating Qualifications of Painting Contractors

b. QP2, Standard Procedure for Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint

c. SP 1, Surface Preparation Specification No. 1, Solvent Cleaning

d. SP 2, Hand Tool Cleaning

e. SP 3, Power Tool Cleaning

f. SP 5, White Metal Blast Cleaning

g. SP 6, Commercial Blast Cleaning

h. SP 7, Brush-Off Blast Cleaning

i. SP 8, Pickling

j. SP 10, Near-White Blast Cleaning

k. SP 11, Power Tool Cleaning to Bare Metal

l. SP 12, High Pressure Water Jetting

m. SP 13, Surface Preparation of Concrete

n. SP 16, Brush off Blast Cleaning of Non-Ferrous Metals.

o. PA1, Best Practices for Paints and Coatings Application

p. PA2, Measurement of Dry Coating Thickness with Magnetic Gauges

q. PA17, Determining Conformance to Steel Profile/Surface Roughness

r. Guide No. 3, PA, Guide to Safety in Paint Applications

7. National Association of Pipe Fabricators (NAPF)

   a. 500-03-01, Solvent Cleaning

   b. 500-03-02, Hand Tool Cleaning

   c. 500-03-03, Power Tool Cleaning

   d. 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe

   e. 500-03-05, Abrasive Blast Cleaning for Ductile Iron Fittings

8. International Concrete Repair Institute (ICRI)

   a. 310.2, Surface Preparation of Concrete

   b. CSP, Concrete Surface Profile

9. NACE International (NACE)

   a. SP-0178, Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.

   b. SP-0188-06, Discontinuity (Holiday) Testing of Protective Coatings

10. ASTM International (ASTM)

    a. ASTM D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.

    b. ASTM D 3359 Standard Test Methods for Rating Adhesion by Tape Test

    c. ASTM D 3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.

    d. ASTM D 4258, Standard Practice for Surface Cleaning Concrete for Coating.

    e. ASTM D 4259, Standard Practice for Abrading Concrete.

    f. ASTM D 4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.

    g. ASTM D 4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.

    h. ASTM D 4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

i. ASTM D 4418, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.

j. ASTM D 4417, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.

k. ASTM D 4541, Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.

l. ASTM D 4787, Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.

m. ASTM D 7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.

n. ASTM D 7234 Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.

o. ASTM E 337, Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).

p. ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

q. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-situ Probes.

1.5 SUBMITTALS

A. Shop Drawings

1. Data Sheets, including catalog cuts and color charts.

a. Material Safety Data Sheets (MSDS), the manufacturer’s Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system.

b. Submit required information on a system-by-system basis.

i. Schedule of proposed coating materials.

ii. Schedule of surfaces to be coated with each coating material.

c. Furnish copies of paint system submittals to the coating applicator.

d. Indiscriminate submittal of manufacturer’s literature only is not acceptable.

e. Thick film coating systems (greater than 25 mils):

i. CSM's detailed written instructions for coating system treatment and graphic

details for coating system terminations in coated structures, including pipe penetrations, metal embedments, gate frames, and other terminations encountered.

ii. Include detail treatment for coating system at concrete joints.

iii. Manufacturer's Representative's (CTR) Field Reports.

2. Detailed chemical and gradation analysis for each proposed abrasive material.

3. System Application Process (for each coating system):

a. Contractor shall indicate surface preparation, primer, stripe coat, finish coat, and quality control parameters as indicated in Section 3.7.

b. Submittal shall include a detailed pre-installation packet with on-site photographs of each edge and transition termination around pipes, gates, frames, edge of coating etc. Drawings on the photographs shall indicate the termination method to be used, in conformance with the coating system manufacturer's recommendations.

c. Submittals shall be approved by the coating manufacturer, the applicator and the General Contractor that is specific to each application system.

B. Quality Control Submittals

1. Applicator's Qualification: List of references substantiating experience.

2. Factory-Applied Coatings: Manufacturer's certification stating factory-applied coating system meets or exceeds requirements specified.

3. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmations that materials are compatible.

4. Manufacturer's written instructions and special details for applying each type of paint.

5. Manufacturer's written verification that submitted material is suitable for the intended use.

6. Qualifications of CSA, including:

a. List of Similar Projects.

b. Name and address of project.

c. Year of installation.

d. Year placed in operation.

e. Point of contact: Name and phone number.

f. Provide a minimum of 5 project references, each including contact name, address, and telephone number where similar coating work has been performed by their company in the past 5 years.

7. CSA Reports:

a. Written daily quality control inspection reports.

8. CTR Reports:

a. Reports on visits to project site to view and approve surface preparation of structures to be coated.

b. Reports on visits to project site to observe and approve coating application procedures.

C. Extended Warranty Certificates

D. Contract Closeout Submittals: Extended Warranty Certificate

1.6 QUALITY CONTROL

A. Qualifications of Applicator: Minimum 5 years' experience in application of specified products.

B. Contractor's Responsibilities

1. The Contractor shall perform first-line, in-process QC inspections and testing in accordance with the level of quality control specified for each coating system.

2. The Contractor shall use the "Daily Coating Inspection Report" found at the end of this specification to record the results of quality control inspections and tests. The completed reports shall be turned in to the Engineer before work resumes the following day.

3. The Contractor shall supply all necessary equipment to perform the QC tests. The instruments shall be calibrated by the Contractor's personnel according to the equipment manufacturer's recommendations and the Contractor's QC Program. All inspection equipment shall be made available to the Engineer for QA observations on an as-needed basis.

4. Equipment shall include the following at a minimum:

a. Recording thermometer.

b. Hygrometer.

c. Recording or comparable equipment for the recording of dew point and continuous recording of relative humidity.

d. Surface temperature thermometer.

e. Hypodermic Needle Pressure Gage for determining blasting pressure at the nozzle.

f. Visual Standard for abrasive blast cleaning.

g. Testex Press-O-Film Replica Tape and Spring Micrometer.

h. Wet Film Thickness Gage.

i. Blotter paper and plate glass for compressed air cleanliness checks.

j. Magnetic Dry Film Thickness Gage with calibration standards.

k. Holiday Detector: Non-destructive wet sponge-type detector. Operating test voltage shall be per NACE RO-02-74 or as recommended by the Coating Manufacturer's representative.

l. A non-sudsing-type wetting agent such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

C. CSA qualifications:

1. Minimum of 5 years of experience applying specified type or types of coatings under conditions similar to those of the Work:

a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 5 years.

2. SSPC QP 1 certified.

3. Manufacturer-approved applicator when manufacturer has approved applicator program or when required in these specifications.

D. CTR qualifications:

1. Certification, one of the following:

a. NACE Level 2 or 3 Certified Coating Inspector.

b. SSPC Level 3 Protective Coatings Inspector.

2. Minimum of 5 years of experience applying manufacturer's coatings under conditions similar to those of the Work:

a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 5 years.

E. Pre-installation conference: Contractor to conduct coatings conference..

1. Coordinate Hold Point schedule

F. CSM services:

1. CSA shall arrange for CTR to attend pre-installation conference.

2. Visit the project site periodically to consult on and inspect specified surface preparation and application Hold Points.

3. CTR shall provide written inspection reports.

G. Conduct and continually inspect work so the coating system is installed as specified. The CSM shall provide written directions to correct coating work not conforming to the specifications or is otherwise unacceptable.

H. Provide written daily reports summarizing test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system application.

1. Confirm that compressed air used for surface preparation or blow-down cleaning is free of oil and moisture.

2. Monitor surface preparation daily at shift's beginning and end and at intervals not to exceed 4 hours during the shift.

3. Do not apply coatings when environmental conditions are outside of the CSM's published limits.

I. Quality Assurance (QA) Observations by Engineer

1. The Engineer will conduct QA observations of any or all phases of the work. The presence or activity of Engineer observations in no way relieves the Contractor of the responsibility to provide all necessary daily QC inspections of his/her own and to comply with all requirements of this Specification.

2. Hold Points: Work that requires a specific inspection upon completion is designated as a Hold Point. The Contractor shall provide the Engineer with a minimum one-day notification before a Hold Point inspection will be reached. Permission to proceed beyond a Hold Point without a QA inspection will be granted solely at the discretion of the Engineer, and only on a case-by-case basis.

3. The Engineer has the right to reject any work that was performed without adequate provision for QA observations.

4. The Engineer will issue a Non-Conformance Report when work is found to be in violation of the specification requirements and is not corrected to bring it into compliance before proceeding with the next phase of work.

5. Inspection Access and Lighting

a. The Contractor shall facilitate the Engineer's observations as required, including allowing ample time to view the work. The Contractor shall furnish, erect, and move scaffolding or other mechanical equipment to permit close observation of all surfaces to be cleaned and painted. This equipment shall be provided during all phases of the work.

b. When the surface to be inspected is more than 1.8 m (6 ft) above the ground or water surface, the Contractor shall provide the Engineer with a safety harness and a lifeline according to OSHA regulations.

c. The Contractor shall provide artificial lighting in areas where natural light is inadequate, as determined by the Engineer, to allow proper cleaning, inspection, and painting. Illumination for inspection shall be at least 325 LUX (30-foot candles). Illumination for cleaning and painting, including the working platforms, access, and entryways shall be at least 215 LUX (20-foot candles).

J. Inspection at Hold Points:

1. Conduct inspections at Hold Points during the coating system application and record the results.

2. Coordinate Hold Points with the Engineer so the Engineer can observe Contractor's inspections on a scheduled basis.

3. Provide the Engineer a minimum of [24] hours of notice before conducting Hold Point Inspections.

4. Hold Points shall be as follows:

a. Conditions before surface preparation: Before starting surface preparation, observe, record, and confirm that oil, grease, and/or soluble salts are gone from the surface.

b. Post surface preparation: After completing surface preparation, measure and inspect for cleanliness and proper surface profile as specified in this Section and in the CSM's written instructions.

c. Coatings application: At the beginning of any coating system application, measure, record, and confirm acceptability of surface and ambient air temperature and humidity. Inspect applicator's equipment for serviceability and suitability for coatings application.

d. Post application inspection: Identify defects in application work on all surfaces, including pinholes, holidays, excessive runs or sags, inadequate or excessive film thickness, and other problems.

e. Follow-up corrective actions and final inspection: Measure and re-inspect corrective coating work performed to repair defects at prior Hold Points, and repeat until the surface condition is acceptable. Conduct final visual inspection with follow-up tests, such as holiday detection, adhesion tests, and DFT surveys.

1.7 SUBSTITUTIONS

A. Products of manufacturers other than those specified, and equal in type and quality to those specified, may be considered acceptable if said products are offered by the Contractor with satisfactory data on past performance, composition and directions for use. No request for substitution will be approved which decreases the film thickness specified and/or number of coats to be applied, or which offers a change from the generic type of paint and coating system specified.

1.8 DELIVERY, STORAGE AND HANDLING

A. All paint shall be delivered to the job site in the manufacturer's original, sealed and labeled containers and shall be subject to inspection and approval by the Engineer prior to use.

B. Shipping

1. Where pre-coated items are to be shipped to the site, protect coating from damage. Batten coated items to prevent abrasion.

2. Use non-metallic or padded slings and straps in handling.

C. Storage

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.

2. Primed surfaces shall not be exposed to weather for more than two months before being topcoated, or less time if recommended by coating manufacturer.

1.9 SERVICES OF MANUFACTURER

A. For submerged and severe service coating systems, the Contractor shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide technical support to resolve field problems associated with the surface preparation requirements and application and curing of the manufacturer's products.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Provide tenting, dehumidification, heating, and other environmental controls necessary to meet the preparation, application, and curing requirements of the coatings used.

1.11 EXTENDED WARRANTIES

A. When specified, provide manufacturer's and contractor's extended warranty for materials and workmanship with Owner named as beneficiary, and shall commence at the time of Substantial Completion.

1.12 PROTECTION OF EXISTING PAINTED STRUCTURES

A. The painting on existing structures and equipment shall be protected. Any damage caused by the Contractor's operation shall be repaired or restored to a condition equal to or better than before it was damaged.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer used as the basis of design: Product names used herein refer to materials manufactured and/or supplied by Tnemec Co. and are used as the basis of quality for design and bidding.

1. Approved Manufacturers – Paint

    a. Tnemec

    b. Sherwin Williams

    c. Pre-approved equal.

B. All paint materials selected for each system for each type of surface shall be the product of a single manufacturer. The type of paint material to be used and the number of coats to be applied are listed in the coating systems specified below.

C. All paint materials and equipment shall be compatible in use. Finish coats shall be compatible with prime coats. Prime coats shall be compatible with the surface to be coated. All tools and equipment shall be compatible with the coating to be applied.

D. Coal tar epoxy and products containing coal tar pitch will not be allowed.

E. Special systems as specified for surface conditions by the manufacturer specified; substitution only upon affidavit of alternate manufacturer that product will meet conditions and label for surface use.

2.2 COLORS

A. Alternating coats shall be contrasting but complimentary to finish coating.

B. All colors and glosses shall be as selected by the Owner.

C. Colors and painting schemes shall match existing colors at project for similar surfaces.

2.3 ABRASIVE MATERIALS

A. Select abrasive type and size to produce a surface profile that meets coating manufacturer’s recommendations.

B. Abrasive blast cleaning shall be performed using either expendable abrasives (other than silica sand) or recyclable steel grit abrasives. Expendable abrasive shall be used one time and disposed of. Abrasive suppliers shall certify that the expendable abrasives meet the requirements of SSPC-AB1 and that recyclable steel grit abrasives meet AB3. The Contractor shall verify that recycled abrasives meet the requirements of SSPC-AB2 during use. All surfaces prepared with abrasives not meeting the SSPC-AB1, AB2, or AB3 requirements, as applicable, shall be solvent cleaned or low pressure water cleaned as directed by the Engineer, and re-blast cleaned at the Contractor's expense.

2.4 THINNERS, CLEANERS, DRIERS, AND OTHER ADDITIVES

A. As recommended by manufacturer of the particular coating.

2.5 VISUAL STANDARD

A. When specified and to facilitate inspection, Contractor shall, on the first day of sandblasting operations, sandblast metal plates to the surface preparation standards specified. Plates shall measure 8½ inches by 6 inches. Plates shall be approved by the Engineer. Plates shall be coated with a clear, non-yellowing finish. One of these plates shall be prepared for each type of sandblasting and shall be used as the comparison standard throughout the project.

PART 3 EXECUTION

3.1 SURFACE PREPARATION, GENERAL

A. Prior to all surface preparation and painting operations, completely mask, remove or otherwise adequately protect all hardware, accessories, machined surfaces, plates, lighting fixtures, equipment, and similar items in contact with painted surfaces but not scheduled to receive paint.

B. All surfaces to be painted shall be in the proper condition to receive the specified paint before said paint is applied. Surface preparation shall be done in a workmanlike manner with the objective of obtaining a clean and dry surface. No more surface preparation than can be coated in a normal working day shall be permitted. No coating shall be applied before the prepared surfaces are approved by the Engineer.

C. Schedule all cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly-painted surfaces.

D. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

E. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. For process piping, mask bolt threads to allow nuts to be removed for maintenance.

F. Mask openings in motors to prevent paint and other materials from entering the motors.

G. Protect all surfaces adjacent to or downward of work area from overspray. Contractor shall be responsible for any damage resulting from overspray.

3.2 SURFACE PREPARATION DESIGNATIONS

A. General:

1. The following designations for surface preparation shall be utilized in the coating systems specified. In no case shall the surface preparation be less than that specified by the Paint Manufacturer. In case of conflict, the more restrictive requirement shall apply.

2. Inspect and provide substrate surfaces prepared in accordance with these Specifications and the printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3. Position diesel- or gasoline-powered equipment in a manner to prevent deposition of combustion contaminants on any part of the structure.

4. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent or whenever surface temperature is less than 5° F above dew point of ambient air.

5. Schedule all cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly-painted surfaces.

6. No more surface preparation than can be coated in a normal working day shall be permitted.

7. No coating shall be applied before the prepared surfaces are approved by the Engineer.

B. Concrete and Masonry*:* All surfaces shall be cleaned of all dust, mortar splatter, curing compounds, grease and other foreign matter. Prepare concrete surfaces per SSPC-SP13, ICRI 310.2 with the appropriate concrete surface profile (CSP) as suggested by the coatings manufacturer. Surface preparation shall conform to the following table:

CONCRETE AND MASONRY SURFACE PREPARATION	
Designation	**Description**
CM-1	**Solvent Cleaning**: Solvent cleaning is a method for removing all visible oil, grease, soil, and other soluble contaminants. Low pressure (1500 – 4000 psi) high volume (3-5 gal/min) water washing with appropriate cleaning chemicals.
CM-2	**Acid Etch**: Clean and etch with 10% muriatic acid solution, scrub thoroughly, neutralize acid, rinse thoroughly, and allow to dry. If curing compound has been used on concrete, clean curing compound off with solenoid prior to acid etching.
CM-3	**Abrasive Blasting**

C. Metal: All surfaces shall be cleaned of all rust, scale, dust and other foreign matter. Sharp edges, burrs and weld spatter shall be removed. Surface preparation shall conform to the

following table and shall be in accordance with the Steel Structures Painting Council (SSPC). Ductile Iron Pipe surface preparation requirements are detailed elsewhere.

METAL SURFACE PREPARATION	
Designation	**Description**
SSPC-SP1	**Solvent Cleaning**: Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Low-pressure (1500 - 4000 psi) high volume (3 - 5 gal/min.) water washing with appropriate cleaning chemicals is a recognized "solvent cleaning" method. All surfaces should be cleaned per this specification prior to using hand tools or blast equipment.
SSPC-SP2	**Hand Tool Cleaning**: Hand Tool Cleaning removes all loose mill scale, loose rust and other detrimental foreign matter. It is not intended that this process remove adherent mill scale, rust and paint. Mil scale, rust and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before hand-tool cleaning, remove visible oil, grease, soluble welding residues and salts by the methods outlined in SSPC-SP1.
SSPC-SP3	**Power Tool Cleaning**: Power Tool Cleaning removes all loose mill scale, loose rust and other detrimental foreign matter. It is not intended that this process remove adherent mill scale, rust and paint. Mil scale, rust and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before power tool cleaning, remove visible oil, grease, soluble welding residues and salts by the methods outlined in SSPC-SP1.
SSPC-SP5	**White Metal Blast Cleaning**: A White Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
SSPC-SP6	**Commercial Blast Cleaning**: A Commercial Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter, except for staining. Staining shall be limited to no more than 33% of each square inch of surface area and may consist of light shadows, slight streaks or minor discoloration caused by stains of rust, stains of mill scale or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
SSPC-SP7	**Brush-Off Blast Cleaning**: A Brush-Off Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust and loose paint. Tightly adherent mill scale, rust and paint may remain on the surface. Mil scale, rust and coating are considered adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed. Before blast cleaning, visible

METAL SURFACE PREPARATION	
Designation	**Description**
	deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
SSPC-SP10	**Near-White Blast Cleaning**: A Near-White Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter, except for staining. Staining shall be limited to no more than 5 percent of each square inch of surface area and may consist of light shadows, slight streaks or minor discoloration caused by stains of rust, stains of mill scale or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.
SSPC-SP11	**Power Tool Cleaning to Bare Metal**: Metallic surfaces that are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted. Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods.
SSPC-SP13	Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.
SSPC-SP16	**Brush-Off Blast Cleaning of Non-Ferrous Metals** SP 16 is intended for brush-off blast cleaning of coated or uncoated metal surfaces other than carbon steel prior to the application of a protective coating system. Surface preparation using this standard is intended to roughen and clean coated and uncoated non-ferrous metal substrates, including, but not limited to, galvanized surfaces, stainless steel, copper, aluminum, and brass. SP 16 requires the cleaned surface to be free of loose contaminants and loose coating as determined by visual inspection. A minimum surface profile of 19 micrometers (0.75 mil) on the bare metal surface is required. Intact coatings are required to be roughened to the degree specified in the project specification.

D. Wood: Wood surfaces shall be thoroughly cleaned and free of all foreign matter. Surface preparation shall conform to the following table:

WOOD SURFACE PREPARATION	
Designation	**Description**
W-1	Clean with mineral spirits, scraping or wire-brushing. Properly fill cracks, nail holes and other defects. Wipe clean of dust.

E. PVC Pipe: PVC pipe shall be clean and dry. Surface preparation shall conform to the following table:

PVC PIPE SURFACE PREPARATION	
Designation	**Description**
P-1	Sand lightly and wipe clean with xylol or toluol solvent. Allow to dry completely.

F. Ductile Iron Pipe and Fittings: Prepare per NAPF 500-03.

1. Per 500-03-01:

    a. Solvent cleansing is a method which shall result in the surface being free of all oil, small deposits of asphalt paint, grease, soil, drawing and cutting compounds and other soluble contaminants from iron surfaces. It is intended that solvent cleaning, when necessary, be used prior to the application of special coating/lining and in conjunction with surface preparation methods specified for the removal of rust, annealing oxide, or mold coating.

2. Per 500-03-02:

    a. Hand tool cleaning is a method of preparing iron surfaces by the use of non-power hand tools which shall result in the surface being free of all loose annealing oxide, loose rust, loose mold coating and other loose detrimental foreign matter. It is not intended that adherent annealing oxide, mold coating and rust be removed by this process. Annealing oxide, mold coating, and rust are considered adherent if they cannot be removed by lifting with a dull putty knife. All asphalt paint must be removed prior to hand tool cleaning.

3. Per 500-03-03:

    a. Power tool cleaning is a method of preparing iron surfaces by the use of power assisted hand tools which shall result in the surface being free of all loose annealing oxide, loose rust, loose mold coating and other loose detrimental foreign matter. It is not intended that adherent annealing oxide, mold coating and rust be removed by this process. Annealing oxide, mold coating, and rust are considered adherent if they cannot be removed by lifting with a dull putty knife. All asphalt paint must be removed prior to power tool cleaning.

4. Per 500-03-04:

    a. Abrasive Blast Cleaning – **External** Pipe Surfaces is a method of preparing the exterior of ductile iron pipe surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. All oils, small deposits of

asphalt paint and grease shall have been removed by solvent cleaning (see NAPF 500-03-01). After the entire surface to be coated is struck by the blast media, tightly adherent annealing oxide, mold coating and rust staining may remain on the surface provided they cannot be removed by lifting with a dull putty knife.

b. Abrasive Blast Cleaning - **Internal** Pipe Surfaces is a method of preparing the interior of ductile iron pipe surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. Internal pipe surface preparation requirements shall be specified by the pipe manufacturer or pipe fabricator as well as the lining manufacturer and shall be based upon testing of a specific lining applied to ductile iron pipe exposed to a specific environment.

5. Per 500-03-05:

a. Abrasive Blast Cleaning - Cast Ductile Iron Fittings. Internal and External Surfaces is a method of repairing the interior and exterior of cast ductile iron fittings surfaces which, when viewed without magnification, shall result in the surface being free of all visible dirt, dust, loose annealing oxide, loose rust, loose mold coating and other foreign matter. All oils, small deposits of asphalt paint and grease shall have been removed by solvent cleaning (see NAPF 500-03-01). Four degrees of abrasive blast cleaning for fittings are available, depending on the type of service for which the fitting is intended and upon the type of coating/lining specified.

3.3 APPLICATION

A. General

1. The application of all coatings shall be in strict accordance with the Manufacturer's Instructions and shall be performed in a manner satisfactory to the Engineer. Painting shall be done at such times as the Contractor and Engineer may agree upon in order that dust-free and neat work be obtained.

2. On metal surfaces, each coat shall be applied at the rate specified by the Manufacturer to achieve the dry mil thickness specified herein. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. Deficiencies in film thickness shall be corrected by the application of additional coats of paint.

3. On masonry or wood, application rates will vary according to surface texture; however, in no case shall the Manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the Contractor's responsibility to achieve a protective and decorative finish, either by decreasing the coverage rate or by applying additional coats of paint.

4. Additional coats of paint shall not be applied until the preceding coat has dried as evidenced by tests with a moisture meter. Drying time shall be construed to mean an interval under normal conditions and shall be increased to allow for adverse weather or

drying conditions.

5. Thinning, when required, shall be done in strict accordance with the Manufacturer's recommendations using the Manufacturer's thinner, or that recommended by the Manufacturer, with knowledge and approval of the Engineer.

6. Use skilled craftsmen and experienced supervision.

7. Apply coating to produce an even film of uniform thickness. Give special attention to edges, corners, crevices, and joints. Ensure thorough cleaning and an adequate thickness of coating material. Apply coatings to produce finished surfaces free from runs, drips, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Effect complete hiding so that the addition of another coat would not increase the hiding. Give special attention to ensure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas. Apply a brushed stripe coat to all edges and welds after priming submerged or severe service areas.

8. Coordinate cleaning and coating so that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

9. Prime surfaces within 12 hours after they are blasted. Re-blast surfaces that have started to rust before they are painted.

10. No paint shall be applied in fog, snow, rain, or to wet or damp surfaces or when air temperatures are below 40° F.

11. Surface temperature shall be at least 5° F above the dew point during final surface preparation and painting.

12. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

13. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.

14. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.

15. Keep paint materials sealed when not in use.

16. Where more than one coat of a material is applied within a given system, alternate color to provide a visual reference that the required number of coats have been applied.

17. The Contractor shall be responsible for ensuring that the shop prime coating is compatible with the finish coating. Materials and application as specified herein shall govern regardless of whether coatings are factory-applied or field-applied. After installation, any damaged areas in prime or finish coatings shall be repaired as directed by the Engineer.

B. Stripe Coating

1. Stripe coat all field welds, edges, angles, fasteners, and other irregular surfaces.

2. Stripe coat shall consist of one coat, brush applied, to the coating thickness specified.

3. Apply stripe coat between primer and intermediate coats.

4. Stripe coat color shall contract with prime coat to allow visual verification of application.

3.4 FACTORY-APPLIED COATINGS AND TOUCH-UP

A. Except where factory or shop application of finish coatings is permitted elsewhere in these Specifications, or by the Engineer in writing, all items shall be finish-painted after installation with the color selected or approved by the Engineer. Shop priming shall be permitted in all cases. The Contractor shall be responsible for insuring that the shop prime coating is compatible with the finish coating. Materials and application as specified herein shall govern regardless of whether coatings are factory-applied or field-applied. After installation, any damaged areas in prime or finish coatings shall be repaired as directed by the Engineer.

3.5 INSPECTION

A. Do not apply additional coats until completed coat has been inspected and approved by the Engineer. Only inspected and approved coats of paint shall be considered in determining the number of coats applied.

3.6 CLEANUP

A. Prevent accidental spilling of paint materials and, in the event of such a spill, immediately remove all spilled material and the waste or other equipment used to clean up the spill, and wash the surfaces to their original, undamaged condition.

B. Upon completion of painting, visually inspect all surfaces and remove all paint and traces of paint from surfaces not specified to be painted.

3.7 QUALITY CONTROL TESTING

A. Owner-provided inspection or inspection by others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Owner inspection is in addition to any inspection required of the Contractor.

B. Contractor shall perform and document quality control testing as specified for each coating system.

1. Level 1 – Minimum required QC test requirements for all painting and coating:

    a. Weather conditions – every 4 hours

    b. Ambient temperatures – every 4 hours

c. Surface temperature – every 4 hours

d. Wet film thickness – every ½ hour

e. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges. DFT's shall be measured in accordance with SSPC-PA2.

2. Level 2 – Testing requirements in addition to Level 1 requirements:

a. Continuous ambient temperature (recording thermometer)

b. Relative humidity – every 4 hours

c. Dew point – every 4 hours

d. Compressed air cleanliness – prior to using compressed air for abrasive blast cleaning, blowing down the surfaces, and painting with conventional spray, the Contractor shall verify that the compressed air is free of moisture and oil contamination according to the requirements of ASTM D4285. The tests shall be conducted at least one time each shirt for each compressor system in operation. If air contamination is evident, the Contractor shall change filters, clean traps, add moisture separators or filters, or make other adjustments as necessary to achieve clean, dry air. The Contractor shall also examine the work performed since the last acceptable test for evidence of defects or contamination caused by the compressed air. Affected work shall be repaired at the Contractor's expense.

e. Blast pressure at nozzle – every 4 hours

f. Visual standard for abrasive blast cleaning

g. Surface profile – every 4 hours

h. Surface pH of concrete surfaces

i. Dry film thickness with magnetic dry film thickness gauge

j. Contractor shall perform holiday testing in accordance with NACE SP0188 to identify holidays or pinholes needing repair for coating over 100 percent of surfaces:

i. Coated steel that will be immersed or exposed to aggressively corrosive conditions.

ii. Coated concrete.

iii. Perform holiday tests after proper application and coating system cure.

iv. Where specifically noted, Contractor shall perform adhesion testing per ASTM D4541 – 17. Pass/fail test pressure, curing conditions required prior to testing, and test location(s) shall be per the coating system manufacturer.

C. Where specifically noted, contractor to perform adhesion testing per ASTM D 3359-17. Curing conditions required prior to testing hall be per coating system manufacturer. Engineer shall witness adhesion testing and contractor shall submit testing report. For Test Method A-X – cut Tape Test of ASTM D 3359-17, only tests resulting in a SA rating are acceptable, and considered as passing. For Test Method B – Cross-cut Tape Test of ASTM D 3359-17, only tests resulting in a 5B rating are acceptable, and considered as passing.

3.8 FINAL INSPECTION

A. Conduct final inspection of coating system work to determine whether it meets specifications requirements.

B. Conduct subsequent final inspection with Engineer to ensure work conforms to contract documents requirements.

C. Mark any rework required.

1. Re-clean and repair, as specified, at no additional cost to the Owner.

3.9 PIPING COLOR CODE AND IDENTIFICATION

A. General:

1. Unless required otherwise by the Engineer, all exposed process and building piping and accessories shall be identified and painted as specified herein and in conformance with this specification.

2. The following piping materials need not be painted with the basic identification color except for colored bands.

   a. Stainless steel

   b. chrome-plated piping

   c. Interior PE/HDPE Piping

   d. Interior PVC/CPVC Piping

3. Where piping is to be identified with colored bands, a three-band system shall be used. The background color, as identified on the pipe schedule, shall appear in the left and right-most bands, with the secondary color located in the center.

4. PVC Piping that extends to the exterior of buildings/structures (i.e., exposed to UV/sunlight) shall be painted completely. Submit to coordinate color with process identification and architectural elements.

5. The entire exposed surface of all other piping and accessories shall be painted according to the color codes indicated in the pipe schedule.

B. Identification Labels:

1. Identify all exposed piping and all piping on each side of each valve; on each side of a branch; on both sides and adjacent to each wall and floor penetrations and not more than 15 feet on center.

2. All chemical piping shall be identified a minimum of two (2) times in each interior room.

3. Identification Tag Requirements:

   a. Name of service as shown on Plans

   b. Flow direction arrows

   c. Position identification so that it is readily visible from eye level.

   d. Block letters on adhesive labels on the finished insulation or pipe with flat black or white enamel contrasting the background pipe color. Label/Text size shall be as noted below. In some instances, as an alternative to painting of identification, an adhesive decal pipe identification system may be approved upon review by the Engineer. Contractor shall submit product information for review by Owner and Engineer as an alternative to painted identification.

SIZE OF LETTERS / ARROWS	
Outside Diameter of Pipe or Covering	**Height of Adhesive Letter**
¾" to 1¼"	½"
1½" to 2"	¾"
2½" to 6"	1¼"
8" to 10"	2½"
Over 10"	3½"

3.10 COATING SYSTEMS

A. Architectural Finishes Including:

1. Gypsum Wall Board

2. Siding and Trim (interior and exterior)

3. Concrete Masonry Units - CMU (interior and exterior)

4. Exterior and Interior Metal Doors, Frames and Vision Lite Frames

5. Exterior Overhead Entry Canopies and Sun Shades

6. For other architectural finishes, reference Section 09 91 00 Architectural Painting.

    a. Where conflicts occur, contractor to adhere to more stringent specifications.

B. **General:** Surface preparation, prime coatings and finish coatings for the various surfaces and items to be painted are specified below. Prime coatings shall be contrasting but complimentary to finish coat.

C. Table 1: Coating System Application Area Descriptions

1. Description: Coating System Application Area Descriptions, includes general descriptions of a systems and a corresponding letter (for example: “A”) to be the designator throughout the rest of the document. Table 2: Applicable Manufacturer Products, includes approved manufacturers and materials for each system. The following pages each correspond to a single system (for example: “A”) and include some details that are necessary for installation. There is also a section labelled Notes at the bottom of each page. These notes can include requirements and reviews of how the systems have performed.

Table 1: Coating System Application Area Descriptions

COATING SYSTEM APPLICATION AREA DESCRIPTIONS	
System A-1	**Exterior Metal and Piping, Non-Submerged (unless specified elsewhere)** Includes, but not limited to, machinery, structural steel beams, columns, bracing, open web steel bar joists, and ancillary structural elements, pumps, pipe hangers, ductile iron pipe, cast iron pipe, galvanized steel pipe, copper pipe, fabrications, PVC pipe, and electrical conduit; *excludes others specifically noted or specified elsewhere.* "Non-submerged" is defined as those items located one (1) foot or more above the maximum water level.
System B-1	**Interior Metal and Piping (unless specified elsewhere)** Includes, but not limited to, machinery, pumps, pipe hangers, ductile iron pipe, cast iron pipe, galvanized steel pipe, steel pipe, copper pipe, fabrications, PVC pipe, and electrical conduit; *excludes others specifically noted or specified elsewhere*.
System B-2	**Interior Structural Components (unless specified elsewhere)** Includes, but not limited to, structural steel beams, columns, bracing, open web steel bar joists, and ancillary structural elements; *excludes others specifically noted or specified elsewhere. SEE NOTES 1, 2 and 3 in System B-2*
System C-1	**Submerged and Intermittently Submerged Metal (unless specified elsewhere)** “Submerged” is defined as all items below one (1) foot above the maximum water level, including submerged elements. Also includes all metal surfaces, structural steel, and metal fabrications in proximity noted above.
System D-1	**Metal, Concrete Encased (unless specified elsewhere)** All metal surfaces, encased in concrete, such as pipes, wall pipes, thimbles, pipe sleeves, gate guides. Excludes reinforcing steel, stainless steel, and galvanized metals.
System D-2	**Aluminum in Contact with Concrete (unless specified elsewhere)**
System E-1	**Epoxy coated floors, walls and sumps (as called-out on the drawings)**
System E-2	**Reinforced Epoxy coated floors, interior walls and ceilings of process tanks and secondary containment (as called-out on the drawings)** **Provide sand-grit floors in secondary chemical containment areas and equipment/pump areas**
System E-3	**Epoxy coated floors, interior walls and secondary containment (as called-out on the drawings)** **Provide sand-grit floors in secondary chemical containment areas and equipment/pump areas**
System F-1	**Concrete process tank interior floor and walls and sumps (unless specified elsewhere)**
System G-1	**Dry fall for interior ceilings**

D. Table 2: Applicable Manufacturer Products

Table 2: Applicable Manufacturer Products

System Designation	Manufacturer	Filler	Primer Coat(s)	Stripe Coat(s)	Intermediate Coat(s)	Finish Coat(s)
A-1	Sherwin-Williams	N/A	Corothane I Mio-Zinc	Macropoxy 5500LT	Macropoxy 5500LT	Acrolon Ultra
	Tnemec	N/A	Series 1 Omnithane	Series 66	N/A	Series 73
B-1	Sherwin-Williams	N/A	Corothane I Mio-Zinc	Macropoxy 5500LT	Macropoxy 5500LT	Macropoxy 5500LT
	Tnemec	N/A	Series 1 Omnithane	Series 66	N/A	Series 66
B-2	Sherwin-Williams	N/A	Shercryl 1300	Shercryl HPA	N/A	Shercryl HPA
	Tnemec	N/A	115 Unibond	Series 1029	N/A	Series 1029
C-1	Sherwin-Williams	N/A	N/A	Macropoxy 5500LT	Sher-Glass FF	Sher-Glass FF
	Tnemec	N/A	Series 1 Omnithane	Series 66	N/A	Series 69
D-1	Sherwin-Williams	N/A	Macropoxy 5500LT	N/A	N/A	Macropoxy 5500LT
	Tnemec	N/A	N/A	N/A	N/A	Series 69
D-2	Sherwin-Williams	N/A	Macropoxy 5500LT	N/A	N/A	Macropoxy 5500LT
	Tnemec	N/A	Series 66	N/A	N/A	Series N69
E-1	Sherwin-Williams	Dura-Plate 2300	Macropoxy 5500LT	N/A	Macropoxy 5500LT	Macropoxy 5500LT
	Tnemec	Series 218	Series 1	N/A	N/A	Series N69
				Series 206 SubFlex EP		
E-2	Sherwin-Williams	N/A	Corobond 100	N/A	Dura-Plate UHS Clear Laminate	Dura-Plate UHS
	Tnemec	Series 218	Thinned	N/A	Intermediate	Series 22

System Designation	Manufacturer	Filler	Primer Coat(s)	Stripe Coat(s)	Intermediate Coat(s)	Finish Coat(s)
			Series N140F		Base Coat: Series 215 with Series 211-15 Mesh Saturant Coat: Thinned Series 22 Epoxoline	Epoxoline
E-3	Sherwin-Williams	Dura-Plate 2300	Corobond 100	N/A	Int. Coat: Dura-Plate 8200 (includes sand grit for horizontal surfaces) Grout Coat: Dura-Plate 8200	General Polymers 4638
	Tnemec	Series 218	Series 201 Epoxoprime	N/A	Int. Coat: Series 280 Tneme-Glaze (includes sand grit for horizontal surfaces) Grout Coat: 280 Tneme-Glaze	Series 290 CRU-Urethane
F-1	Sherwin-Williams	Dura-Plate 2300	Macropoxy 5500LT 2-3	N/A	N/A	Macropoxy 5500LT
	Tnemec	Series 218	N/A	N/A	N/A	Series 141
G-1	Sherwin-Williams	N/A	Spraylastic Waterborne		N/A	Spraylastic Waterborne
	Tnemec	N/A	115 Unibond	Series 1029	N/A	Series 1029

The following pages include the System Application Data Sheets and their corresponding details.

1. System: A-1

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	1. Bare Metal (Steel). SSPC-SP6 or as approved by the Engineer 2. Primed Metal (Ductile or Cast Iron). SSPC-SP1 and SSPC-SP7 (or SP3) 3. PVC per this specification	• Same as Tnemec
Generic Type Primer:	• Modified Aromatic Polyurethane	• Same as Tnemec
Generic Type Intermediate Coat:	• N/A	• N/A
Generic Type Finish:	• Acrylic Polyurethane	• Same as Tnemec
Generic Type Stripe Coat:	• Per Manufacturer recommendations	• Same as Tnemec
Generic Type Surface/Filler:	• N/A	• N/A
Primer Thickness:	• 3.0 to 4.0 MDFT	• N/A
Intermediate Coat Thickness:	• N/A	• 4.0 to 6.0 MDFT
Finish Coat Thickness:	• 2.0 to 5.0 MDFT	• 2.0 to 3.0 MDFT
Stripe Coat Thickness:	• Stripe coat shall be used as necessary to insure proper dry film thickness and a pin-hole free surface.	• Same as Tnemec
Surface/Filler Thickness:	• N/A	• N/A
Quality Control:	• Level 1 and 2	• Same as Tnemec
Extended Warranty:	• Three (3) Years. At the completion of the work, stencil the date on the structure/machine in 2-inch-high capital letters containing the following wording: “PAINTED (insert month and year in which painting was completed)”.	• Same as Tnemec

2. System: B-1

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	1. Bare Metal (Steel). SSPC-SP6 2. Primed Metal (Ductile or Cast Iron). SSPC-SP1 and SSPC-SP7 (or SP3) 3. Galvanized Metal. SSPC-SP1 and SSPC-SP3 4. PVC. P-1	• Same as Tnemec
Generic Type Primer:	• Modified Aromatic Polyurethane	• Same as Tnemec
Generic Type Intermediate Coat:	• N/A	• N/A
Generic Type Finish Coat:	• Polyamide epoxy	• Polyamidoamine
Generic Type Stripe Coat:	• Polyamide epoxy	• Polyamidoamine
Generic Type Surface/Filler:	• N/A	• N/A
Primer Thickness: **Intermediate Coat Thickness:**	• 3.0 to 4.0 MDFT • N/A	• • 3.0 to 4.0 MDFT
Finish Coat Thickness:	• 3.0 to 4.0 MDFT	• Same as Tnemec
Stripe Coat Thickness:	• 3.0 to 4.0 MDFT. Stripe coat shall be used as necessary to insure proper dry film thickness and a pin-hole free surface as necessary.	• Same as Tnemec
Surface/Filler Thickness:	• N/A	• N/A
Quality Control:	• Level 1 and 2	• Same as Tnemec
Extended Warranty:	• Three (3) Years. At the completion of the work, stencil the date on the structure/machine in 2-inch-high capital letters containing the following wording: “PAINTED (insert month and year in which painting was completed)”.	• Same as Tnemec

Notes:

1. All bituminous coated metals shall be sealed prior to the application of the prime coat to prevent bleeding. Sealer shall be compatible with other coatings.
2. Fabrications and elements that are not Factory Shop-Coated in conformance with this specification with Primer, Stripe and Finish Coats shall be prepared and field coated (or shop coated) per this specification prior to erection on-site. Following erection of structural steel elements, coatings shall be touched-up in the field to repair damaged areas per this specification.

3. System: B-2

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	1. Bare Metal: SSPC-SP6 2. Primed Metal SSPC-SP7	• Same as Tnemec
Generic Type Primer:	• Self-crosslinking Hydrophobic Acrylic	• Same as Tnemec
Generic Type Finish Coat:	• HDP Acrylic Polymer	• Same as Tnemec
Generic Type Stripe Coat:	• HDP Acrylic Polymer	• Same as Tnemec
Primer Thickness:	• 2 to 4 MDFT	• Same as Tnemec
Finish Coat Thickness:	• 2 to 4 MDFT	• Same as Tnemec
Stripe Coat Thickness:	• 2 to 4 MDFT Stripe coat shall be used to ensure proper coverage on all edges.	• Same as Tnemec
Quality Control:	• Level 1 and Level 2	• Same as Tnemec
Extended Warranty:	• Three (3) Years. At the completion of the work, stencil the date on the structure/machine in 2-inch-high capital letters containing the following wording: “PAINTED (insert month and year in which painting was completed)”.	• Same as Tnemec

Notes:

1. All bituminous coated metals shall be sealed prior to the application of the prime coat to prevent bleeding. Sealer shall be compatible with other coatings.
2. STRUCTURAL STEEL fabrications and elements that are not Factory Shop-Coated in conformance with this specification with Primer, Stripe and Finish Coats shall be prepared and field coated (or shop coated) per this specification prior to erection on-site. Following erection of structural steel elements, coatings shall be touched-up in the field to repair damaged areas per this specification.
3. Bar joist factory hold priming and dip priming shall not be considered in conformance with this specification and shall be removed and re-coated per these specifications on-site or at Contractors facility.

4. System: C-1

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	1. Bare Metal. SSPC-SP10 2. Primed Metal. SSPC-SP1 and SSPC-SP3, scarify the surface	• Same as Tnemec
Generic Type Primer:	• Modified Aromatic Polyurethane	• Same as Tnemec
Generic Type Finish Coat:	• Polyamidoamine Epoxy	• Polyamidoamine
Generic Type Stripe Coat:	• Polyamide Epoxy	• Same as Tnemec
Generic Type Surface/Filler:	• N/A	• N/A
Primer Thickness:	• 3.0 to 5.0 MDFT	• Same as Tnemec
Finish Coat Thickness:	• Two (2) coats, 8.0 to 10.0 MDFT/coat	• Same as Tnemec
Stripe Coat Thickness:	• Stripe coat shall be used as necessary to insure proper dry film thickness and a pin-hole free surface.	• Same as Tnemec
Surface/Filler Thickness:	• N/A	• N/A
Quality Control:	• Level 1 and 2	• Same as Tnemec
Extended Warranty:	• Three (3) Years. At the completion of the work, stencil the date on the structure/machine in 2-inch-high capital letters containing the following wording: “PAINTED (insert month and year in which painting was completed)”.	• Same as Tnemec

5. System: D-1

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	• Bare Metal (Steel). SSPC-SP6	• Same as Tnemec
Generic Type Primer:	• N/A	• N/A
Generic Type Intermediate Coat:	• N/A	• N/A
Generic Type Finish Coat:	• Polyamidoamine Epoxy	• Same as Tnemec
Generic Type Stripe Coat:	• Polyamidoamine Epoxy	• Same as Tnemec
Generic Type Surface/Filler:	• N/A	• N/A
Primer Thickness:	• N/A	• N/A
Intermediate Coat Thickness:	• N/A	• N/A
Finish Coat Thickness:	• Two (2) coats, 8.0 to 10.0 MDFT/coat	• Same as Tnemec
Stripe Coat Thickness:	• Stripe coat shall be used as necessary to insure proper dry film thickness and a pin-hole free surface.	• Same as Tnemec
Surface/Filler Thickness:	• N/A	• N/A
Quality Control:	• Level 1 and 2	• Same as Tnemec
Extended Warranty:	• None	• Same as Tnemec

6. System: D-2

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	• SSPC-SP1 and SSPC-SP16 (Scarify, degloss and provide 1 mil profile)	• Same as Tnemec
Generic Type Primer:	• Polyamide Epoxy	• Polyamidoamine
Generic Type Intermediate Coat:	• N/A	• N/A
Generic Type Finish Coat:	• Polyamidoamine Epoxy	• Same as Tnemec
Generic Type Stripe Coat:	• Polyamide Epoxy	• Polyamidoamine
Generic Type Surface/Filler:	• N/A	• N/A
Primer Thickness:	• 3-5 MDFT	• Same as Tnemec
Intermediate Coat Thickness:	• N/A	• N/A
Finish Coat Thickness:	• 6 to 8 MDFT	• Same as Tnemec
Stripe Coat Thickness:	• Stripe coat shall be used to insure proper coverage on all sharp edges.	• Same as Tnemec
Surface/Filler Thickness:	• N/A	• N/A
Quality Control:	• Level 1	• Same as Tnemec
Extended Warranty:	• None	• Same as Tnemec

7. System: E-1

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	• CM-1, and additional prep as recommended by manufacturer	• Same as Tnemec
Generic Type Surface/Filler:	• Epoxy Modified Cementitious Mortar	• Same as Tnemec
Generic Type Primer:	• Modified Aromatic Polyurethane Primer	• Same as Tnemec
Generic Type Stripe Coat:	• Polyamidoamine epoxy	• Same as Tnemec
Generic Type Finish Coat:	• Polyamidoamine Epoxy	• Same as Tnemec
Primer Thickness:	• 2.5 to 3.5 MDFT	• Same as Tnemec
Intermediate Coat Thickness:	• N/A	• N/A
Surface/Filler Thickness:	• Fill bug holes, rock pockets, and pinholes, 1/16" to ¼" thickness per lift, maximum ½" thickness	• Same as Tnemec
Stripe Coat Thickness:	• A stripe coat shall be used as necessary to insure proper dry film thickness and a pin-hole free surface.	• Same as Tnemec
Finish Coat Thickness:	• Two (2) coats, 4.0 to 6.0 MDFT/coat	• Same as Tnemec
Quality Control:	• Level 1 and 2	• Same as Tnemec
Extended Warranty:	• None	• Same as Tnemec

Notes:

1. Apply to all concrete sump surfaces; walls, floor. Apply after completion of all grouting and proper concrete cure.
2. Reference manufacturer's application guide for termination details (edge of coating terminations). Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE RP0188-90 to verify a pinhole-free surface.

8. System: E-2

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	• Surface Preparation: Prepare in accordance with SSPC-13/NACE 6 and ICRI Technical Guidelines. Abrasive Blast, shot- blast or mechanically abrade concrete surfaces to provide a minimum ICRI-CSP 3 or greater surface profile.	• Same as Tnemec
Generic Type Surface/Filler:	• Epoxy Modified Cementitious Mortar	• Same as Tnemec
Generic Type Primer Coat:	• Polyamidoamine Epoxy	• Same as Tnemec
Generic Type Intermediate Basecoat:	• Modified Polyamine Epoxy	• Same as Tnemec
Saturant Coat:	• Modified Polyamine Epoxy	• Same as Tnemec
Generic Type Finish (top) Coat:	• Modified Polyamine Epoxy	• Same as Tnemec
Surface/Filler:	• Fill flush to plane all bug holes and surface voids as a result of the abrasive blasting process.	• Same as Tnemec
Primer Coat Thickness:	• To all horizontal and vertical surfaces, roller-apply a prime coat of Series N140F at a thickness of 3.0–4.0 mils DFT, thinned up to 10% with Tnemec No. 4 Thinner.	• To all horizontal and vertical surfaces, roller-apply a primer coat of Corobond 100 at a thickness of 3.0-4.0 mils DFT.
Intermediate Basecoat Thickness:	• To all horizontal (floors and ceilings) and vertical surfaces, trowel-apply, or spray transfer and trowel-finish full parge coat of Series 215 Surfacing Epoxy at a thickness of 60.0–80.0 mils DFT. • Embed Series 211-215, ¾ ounce fiberglass mat into basecoat while still wet, overlap edges 2 inches and smooth with ribbed roller to remove any voids or wrinkles.	• Apply Dura-plate UHS Clear Laminate to all surfaces at 40-50 mils DFT. For vertical surfaces, add ½ to 1 ½ lbs of fumed silica. 2.5-3.2 gallons of mixed material with 10.5 lbs of glass mat will cover approximately 100 sqft at 40-50 mils DFT.
Saturant Coat Thickness:	• Saturate top of fiberglass mat completely with Series 22 Epoxoline at 8.0–12.0 mils, thinned up to 5% with Tnemec No. 2	• Same as Tnemec

	Thinner, until glass attains a uniform, wet-out appearance. Do not over-saturate. Once cured, sand to remove any imperfections or raised fibers that protrude through film. Grind if necessary.	
Finish (top) Coat and Thickness:	• To all horizontal and vertical surfaces, roller-apply topcoat of Series 22 Epoxoline at 20.0–30.0 mils DFT.	• Apply a finish coat of Dura-Plate UHS at 18.0-22.0 mils DFT.
Quality Control:	• Level 1 and 2	• Same as Tnemec
Extended Warranty:	• None	• Same as Tnemec

Notes:

1. Reference manufacturer's application guide for termination details (edge of coating terminations).
2. Reference manufacturer's application guide for termination details (edge of coating terminations). Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE RP0188-90 to verify a pinhole-free surface.

9. System: E-3

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	• Surface Preparation: Prepare in accordance with SSPC-13/NACE 6 and ICRI Technical Guidelines. Abrasive Blast, shot- blast or mechanically abrade concrete surfaces to provide a minimum ICRI-CSP 3 or greater surface profile.	• Same as Tnemec
Generic Type Surface/Filler:	• Epoxy Modified Cementitious Mortar	• Same as Tnemec
Generic Type Primer Coat:	• Moisture tolerant epoxy primer	• Same as Tnemec
Generic Type Intermediate Coat:	• Modified Polyamine Epoxy	• Novolac Epoxy
Grout Coat:	• Modified Polyamine Epoxy	• Novolac Epoxy
Generic Type Finish (top) Coat:	• Aliphatic Polyester Polyurethane	• Same as Tnemec
Surface/Filter Thickness:	• Fill flush to plane all bug holes and surface voids as a result of the abrasive blasting process.	• Same as Tnemec
Primer Coat Thickness:	• 6 to 12 mils DFT; Coverage at 160 - 200 square feet per gallon	• Apply Corobond 100 at 3.0-4.0 mils DFT
Intermediate Coat Thickness:	• 6 to 10 mils DFT; Coverage at 160-200 square feet per gallon • For texture/tread on horizontal walking surfaces - randomly broadcast 30/50 mesh aggregate into the wet Intermediate Coat to refusal	• Apply Dura-Plate 8200 at 15-20 mils DFT. For texture, broadcast to refusal with 20-40 mesh dry washed silica
Grout Coat Thickness:	• 8 to 10 mils DFT	• Apply Dura-Plate 8200 at 15-20 mils DFT.

Finish (top) Coat and Thickness:	• 2 to 3 mils DFT; Coverage at 390-425 square feet per gallon • The finished appearance and texture will depend on the film thickness and number of coats applied. 4'x 4' Mock-ups shall be applied to determine the desired finish appearance and texture.	• Apply finish coat of General Polymers 4638 at 3.0-4.0 mils.
Quality Control:	• Level 1 and 2	• Same as Tnemec
Extended Warranty:	• None	• Same as Tnemec

Notes:

1. Reference manufacturer's application guide for termination details (edge of coating terminations).
2. Reference manufacturer's application guide for termination details (edge of coating terminations). Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE RP0188-90 to verify a pinhole-free surface.

10. System: F-1

	TNEMEC	SHERWIN WILLIAMS
Surface Preparation:	• SSPC SP 13 to meet ICRI CSP5 surface profile all surfaces to be coated. Surface shall be clean, dry, and free of contaminants. CM-3 minimum.	• SSPC SP 13 to meet ICRI CSP2-3 surface profile all surfaces to be coated. Surface shall be clean, dry, and free of contaminants. CM-3 minimum.
Generic Type Primer:	• Modified Polyamine Epoxy	• Polyamidoamine
Generic Type Intermediate Coat:	• N/A	• N/A
Generic Type Finish Coat:	• Modified Polyamine Epoxy	• Polyamidoamine
Generic Type Stripe Coat:	• Modified Polyamine Epoxy	• Same as Tnemec
Generic Type Surface/Filler:	• Epoxy Modified Cementitious Mortar	• Same as Tnemec
Primer Thickness:	• N/A	• 2.0 to 3.0 mils DFT
Intermediate Coat Thickness:	• N/A	• N/A
Finish Coat Thickness:	• 14 to 16 MDFT in one-coat application	• 12 to 14 mils DFT
Stripe Coat Thickness:	• Per Manufacturer Recommendations.	• Same as Tnemec
Surface/Filler Thickness:	• 1/32" minimum thickness. Fill surface voids flush to plane to ensure finish is monolithic and pinhole free.	• Same as Tnemec
Quality Control:	• Level 1 and 2 and as specified below	• Same as Tnemec
Extended Warranty:	• Three (3) Years. At the completion of the work, stencil the date on the structure/machine in 2-inch-high capital letters containing the following wording: “PAINTED (insert month and year in which painting was completed)”.	• Same as Tnemec

Notes:

1. Coating system shall be applied only by coating-system certified contractor. Applicator must be trained and certified as an installer by the manufacturer of the product which they are applying.
2. Alternative coating systems submitted for substitution approval for this system shall be reviewed for approval by the Engineer.
3. Reference manufacturer's application guide for termination details (edge of coating terminations). Upon full cure, the installed lining system shall be checked by high voltage spark detection in accordance with NACE RP0188-90 to verify a pinhole-free surface.

11. System: G-1

	TNEMEC	SHERWIN-WILLIAMS
Surface Preparation:	1. Bare Metal: SSPC-SP6 2. Primed Metal SSPC-SP7 3. Galvanized Metal Composite Deck: SSPC-SP1 and SSPC-SP3. Clean galvanized metal deck with Clean n' Etch (Mfr. Great Lakes Laboratories) per manufacturers recommendations for passivated galvanized surfaces.	• Same as Tnemec
Generic Type Primer:	• Self-crosslinking Hydrophobic Acrylic	• Same as Tnemec
Generic Type Finish Coat:	• HDP Acrylic Polymer	• Same as Tnemec
Generic Type Stripe Coat:	• HDP Acrylic Polymer	• Same as Tnemec
Primer Thickness:	• 2 to 4 MDFT	• Same as Tnemec
Finish Coat Thickness:	• 2 to 4 MDFT	• Same as Tnemec
Stripe Coat Thickness:	• As required.	• Same as Tnemec
Quality Control:	• Level 1 and Level 2	• Same as Tnemec
Extended Warranty:	• Three (3) Years. At the completion of the work, stencil the date on the structure/machine in 2-inch-high capital letters containing the following wording: "PAINTED (insert month and year in which painting was completed)".	• Same as Tnemec

Notes:

1. Specifications for Open Web Steel Bar-Joists and structural steel are specified elsewhere.

END OF SECTION

Paint Inspection:

Daily Coating Inspection Report

Project/Client:
Location:
Description:
Requirements:
Contractor:

Date: / / M T W Th F S Su
Project #:
Inspector:
Spec #

Pg. Of
COPY To:
☐ QC Mgr ☐ Owner
☐ Contr ☐ _____
Attachments:
☐ DFT Sheet ☐ NCR/CAR
☐ _____
Revision #

Description of Areas & Work Performed

Hold Point Inspections Performed

- ☐ 1 Pre Surface Pep/Condition & Cleanliness
- ☐ 2 Surface Preparation Monitoring
- ☐ 3 Post Surface Preparation/Cleanliness & Profile
- ☐ 4 Pre Application Prep/Surface Cleanliness
- ☐ 5 Application Monitoring/Wet Film Thickness (WFT)
- ☐ 6 Post Application/Application Defects
- ☐ 7 Post Cure/Dry Film Thickness (DFT)
- ☐ 8 Nonconformance/Corrective Actions Follow-up
- ☐ 9 Final Inspection

Approved By: _____

Surface Conditions

☐ New ☐ Maint ☐ Primer/Paint ☐ Age/Dry/Cure_____
☐ Steel ☐ Galvanize ☐ Concrete ☐ Other_____
☐ Hazard _____ ☐ Sample Report # _____
☐ Degree of contamination: _____
Test: ☐ Cl_____ µg/cm² / ppm ☐ Fe ____ppm ☐ pH _____
☐ Degree of Corrosion: _____
☐ Scale ☐ Pitting/Holes ☐ Crevices ☐ Sharp Edges
☐ Weld _____ ☐ Moisture ☐ Oils ☐ Other_____
☐ Painted Surface Condition: _____
Dry to: ☐ Touch ☐ Handle ☐ Recoat
☐ Dry/Over Spray ☐ Runs/Sags ☐ Pinholes ☐ Holidays
☐ Abrasion ☐ Fall Out ☐ Other _____

Surface Preparation

Start Time: Finish Time: Est Sq/ft:
☐ Solvent Clean ☐ Hand Tool ☐ Power Tool
☐ HP Wash PSI_____ ☐ Other _____
☐ Abrasive Blast ☐ Abrasive Type _____ ☐ Sample
☐ Blast Hose Size _____ ☐ Nozzle Size / PSI _____
☐ Air Supply CFM _____ ☐ Air Supply Cleanliness
☐ Water/Oil Trap Check ☐ Equipment Condition Check

Surface Cleanliness & Profile Measurement

☐ Job Specification ☐ SSPC/NACE - SP- _____
☐ SSPC/NACE Spec / Visual Stds ☐ _____
Profile Check: _____ ☐ Disc ☐ Tape ☐ Gauge
☐ Specified_____mils avg. / Achieved _____mils
☐ Surface effect on DFT Gauge/BMR_____mils

Dry Film Thickness

Gage Type / Model	Gage Serial #	Gage Calib. Verified	Spec Avg. DFT	Total Avg DFT	DFT Last Coat	DFT This Coat

Ambient Conditions

Time (Indicate AM or PM)	:	:	:	:
Dry Bulb Temp° (C/F)	°	°	°	°
Wet Bulb Temp° (C/F)	°	°	°	°
% Relative Humidity	%	%	%	%
Surface Temp° (C/F) Min/Max	/ °	/ °	/ °	/ °
Dew Point Temp° (C/F)	°	°	°	°
Wind Direction/Speed				
Weather Conditions:				

Application

Start Time : Finish Time : Est. Sq/ft.
☐ Primer ☐ Intermediate ☐ Topcoat ☐ Touch-up

Generic Type:	Qty Mixed:
Manuf.:	Mix Ratio:
Prod Name:	Mix Method:
Prod #:	Strain/Screen:
Color:	Material Temp: °F
Kit Sz/Cond.:	Sweat-in Time: Min/Hrs
Shelf Life:	Pot Life: Min/Hrs

Batch #'s

(A)	Reducer #:
(B)	Qty Added: Pt/Qt/Gal
(C)	% by Vol: %
Reducer:	Specified WFT Avg: Mils
	Achieved WFT Avg: Mils

☐ Airless/Conv. Spray ☐ Brush ☐ Roller ☐ Other _____

Pump Pot	Hose Dia.	Air Check
Ratio/Size	Hose Lng.	SEP/Trap
GPM/CFM	Spray Gun	Filter
PSI	Tip Sz.	Agitator

Inspector's Signature Date

SSPC the society for protective coatings Created03/03 by

SECTION 09 91 00

ARCHITECTURAL PAINTING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes surface preparation and field painting of exposed exterior and interior architectural items and surfaces.
   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. The WORK of this Section requires painting surfaces as described in the Finish Schedules on the Architectural Drawings. In case of conflict between the provisions of this Section and Section 09 96 00, the provisions of Section 09 96 00 shall take precedence.

C. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
   2. Walls behind scheduled coverings shall receive prime coat.
   3. If it can be seen, paint it.

D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Prefinished items include the following factory-finished components:
      a. Architectural woodwork.
      b. Acoustical wall panels.
      c. Finished mechanical and electrical equipment.
      d. Light fixtures.
      e. Anodized aluminum door and window frames
   2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
      a. Foundation spaces.
      b. Furred areas.
      c. Ceiling plenums.
      d. Utility tunnels.
      e. Pipe spaces.
      f. Duct shafts.

3. Finished metal surfaces include the following:
    a. Anodized aluminum.
    b. Stainless steel.
    c. Chromium plate.
    d. Copper and copper alloys.
    e. Bronze and brass.
4. Operating parts include moving parts of operating equipment and the following:
    a. Valve and damper operators.
    b. Linkages.
    c. Sensing devices.
    d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

E. Related Sections include the following:
1. Division 2 Section "Cement Concrete Pavement" for traffic-marking paint.
2. Division 5 Section "Structural Steel" for shop priming structural steel.
3. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
4. Division 6 Section "Interior Architectural Woodwork" for shop priming interior architectural woodwork.
5. Division 8 Section "Steel Door Frames" for factory priming steel doors and frames.
6. Division 9 Section "Gypsum Board" for surface preparation of gypsum board.

1.02 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.03 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.
1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of finish-coat material indicated.
   1. After color selection, Architect will furnish color chips for surfaces to be coated.

C. Qualification Data: For Applicator.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.
   8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.06 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.07 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
   1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. (3.8 L) or 1 case, as appropriate, of each material and color applied.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
   1. Sherwin-Williams Co. (Sherwin-Williams).
   2. Benjamin Moore & Co. (Benjamin Moore).
   3. ICI Dulux Paint Centers (ICI Dulux Paints).
   4. PPG Industries, Inc. (Pittsburgh Paints).

2.02 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Match Architect's samples and as selected by Architect from manufacturer's full range.

2.03 CONCRETE UNIT MASONRY BLOCK FILLERS

A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
   1. Sherwin-Williams; Heavy Duty Block Filler B42W46: Applied at a dry film thickness of not less than 10.0 mils (0.254 mm).

2.04 EXTERIOR PRIMERS

A. Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.
   1. Sherwin-Williams; ProCryl Universal Primer B66-310 Series (<50 g/L): Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

B. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
   1. Sherwin-Williams; DTM Wash Primer B71 Series: Applied at a dry film thickness of more less than 1.4 milsdry film thickness. .

C. Exterior Aluminum Primer under Acrylic Finishes: Factory-formulated acrylic-based metal primer for exterior application.
   1. Sherwin-Williams; DTM Acrylic Primer/Finish B66W1: Applied at a dry film thickness of not less than 3.0 mils.

2.05 INTERIOR PRIMERS

A. Interior Concrete and Masonry Primer for Walls: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
   1. Sherwin-Williams; Heavy Duty Block filler B42W46: Applied at a dry film thickness of not less than 10.0 mils (0.254 mm).

B. Interior Concrete Floor Primer: Factory-formulated 2 component, water based epoxy primer for interior application.
   1. Sherwin-Williams; : Resuprime 3477 Epoxy Sealer. Applied at a dry film thickness of not less than 2.0 mils (0.152 mm) (3.0 mils wet).

C. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
   1. All areas except as scheduled for Wet Areas: Sherwin-Williams; ProMar 200 Zero Primer B28 Series (<50 VOC): Applied at a dry film thickness of not less than 1.0 mils (0.033 mm).
   2. Wet Areas (Scheduled for Epoxy Finish Coat): Sherwin-Williams; S-W PrepRite ProBlock Latex Primer, B28. Applied at a dry film thickness of not less than 1.2 mils (0.030 mm) (4 mils wet).

D. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive metal primer.
   1. Sherwin-Williams; ProCryl Universal Primer B66-310 Series (<50g/L): Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

E. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
   1. Sherwin-Williams; Zinc Clad 4100: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

2.06 EXTERIOR FINISH COATS

A. Exterior Full-Gloss Acrylic Enamel for Ferrous and Other Metals: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
   1. Sherwin-Williams; Sher-Cryl High Performance Acrylic, B66-300 Series (192 g/L): Applied at a dry film thickness of not less than 4.0 mils (0.101 mm).

B. Exterior Full-Gloss Alkyd Enamel: Factory-formulated full-gloss alkyd enamel for exterior application.
   1. Sherwin-Williams; Pro Industrial WB Urethane Alkyd Enameleries (<250 g/L): Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

C. Exterior Full-Gloss Urethane: Factory-formulated full-gloss urethane for exterior application.
   1. Sherwin-Williams; High Solids Polyurethane 250 B65 Series (<250 g/L): Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

2.07 INTERIOR FINISH COATS

A. Interior Flat Acrylic Paint: Factory-formulated flat acrylic-emulsion latex paint for interior application.
   1. Sherwin-Williams; ProMar 200 Zero Interior Latex Flat B30 Series (0 VOC): Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
   1. Sherwin-Williams; Scuff Tuff Interior WB Enamel S24 Series (0 VOC): Applied at a dry film thickness of not less than 1.2 mils (0.041 mm).

C. Interior Semigloss Acrylic: Factory-formulated semigloss acrylic-latex enamel for interior application.
   1. Sherwin-Williams; ProMar 200 Zero Interior Latex Semi-Gloss B31 Series (0 VOC): Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

D. Interior Semi-Gloss Acrylic Coating: Factory-formulated semigloss water based acrylic dryfall coating.
   1. Sherwin-Williams; Pro Industrial Multi Surface Acrylic B66 Series. Applied at a dry film thickness of not less than 1.5 mils dry

E. Interior Full Gloss 100% Solids Epoxy for Concrete Floors: Factory-formulated 2 component, high performance, recoatable epoxy:
   1. Sherwin-Williams; Resuflor 3746 High Performance Epoxy. Applied at a wet film thickness of not less than 12.0 mils (0.309 mm) (12.0 mils wet).

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
   1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.02 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime.
   2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
      a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
      b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
   a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
   b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
   c. If transparent finish is required, backprime with spar varnish.
   d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.
   e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
   2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   3. Provide finish coats that are compatible with primers used.
   4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
   5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
   7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
   8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
   9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
   2. Omit primer over metal surfaces that have been shop primed and touchup painted.
   3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
   4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
   1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.

3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical items to be painted include, but are not limited to, the following:
   1. Uninsulated metal piping.
   2. Uninsulated plastic piping.
   3. Pipe hangers and supports.
   4. Tanks that do not have factory-applied final finishes.
   5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
   7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

F. Electrical items to be painted include, but are not limited to, the following:
   1. Switchgear.
   2. Panelboards.
   3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

G. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

J. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
   1. Provide satin finish for final coats.

K. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
   1. Owner may engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
   2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.05 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.06 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
   1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces.

3.07 EXTERIOR PAINT SCHEDULE

A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a rust-inhibitive primer.
      a. Primer: Exterior ferrous-metal primer.
      b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
   2. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a rust-inhibitive primer.
      a. Primer: Exterior ferrous-metal primer.

b. Finish Coats: Exterior full-gloss alkyd enamel.

3. Full-Gloss Urethane Finish: Two finish coats over a rust-inhibitive primer.
   a. Primer: Exterior ferrous-metal primer.
   b. Finish Coats: Exterior full-gloss urethane.

B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces:
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a galvanized metal primer.
      a. Primer: Exterior galvanized metal primer.
      b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.

C. Aluminum: Provide the following finish systems over exterior aluminum surfaces:
   1. Full-Gloss Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Exterior aluminum primer under acrylic finishes.
      b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.

3.08 INTERIOR PAINT SCHEDULE

A. Concrete and Masonry (Other Than Concrete Unit Masonry): Provide the following paint systems over interior concrete and brick masonry substrates:
   1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Interior concrete and masonry primer.
      b. Finish Coats: Interior semigloss acrylic enamel.

B. Concrete Unit Masonry: Provide the following finish systems over interior concrete masonry:
   1. Semigloss Acrylic-Enamel Finish: Two finish coats over a block filler.
      a. Block Filler: Concrete unit masonry block filler.
      b. Finish Coats: Interior semigloss acrylic enamel.

C. Concrete Unit Masonry for Epoxy Finish: Provide the following finish systems over interior concrete masonry:
   1. Gloss Epoxy Finish: Two finish coats over a block filler.
      a. Block Filler: Concrete unit masonry block filler.
      b. Finish Coats: Interior gloss epoxy.

D. Concrete Floor Sealer (Rain Guard Floor-Loc with Micro-Loc): Provide the following finish systems over interior concrete floors:
   1. Clear silane / silozane ASTM C-309
   2. Remove all oil, grease and loose particles.
   3. 2 coats: 400 SFPGPC

E. Concrete Wall Sealer (MasterProtect H 107): Provide the following finish systems over interior concrete and cement base fire proofing at walls & Ceilings:

1. Clear silane / silozane ASTM C-309
2. Remove all oil, grease and loose particles.
3. 2 coats: 400 SFPGPC

F. Concrete Floors Non Skid Epoxy: Provide the following finish systems over interior concrete floors:
   1. Full Gloss Epoxy Finish: Two finish coats (15 mils) over a primer.
      a. Primer: Interior concrete floor primer; S-W Resuprime 3579
      b. Finish Coats: Interior full gloss 100% solids self-leveling epoxy; S-W Resuflor 3746

G. Metal (Structural Steel)
   1. Ferrous and Non-Ferrous- (Galvanized Ductwork, Piping, Conduit, Door Frames)
      a. Acrylic Coating
      b. Semi-Gloss Finish
      c. 1st Coat: S-W Pro Industrial Multi Surface Acrylic, B66 Series. (1.5 -3 mils dry)
      d. 2nd Coat: S-W Pro Industrial Multi Surface Acrylic, B66 Series. (1.5 -3 mils dry)

H. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
   1. Flat Acrylic Finish: Two finish coats over a primer.
      a. Primer: Interior gypsum board primer.
      b. Finish Coats: Interior flat acrylic paint.
   2. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Interior gypsum board primer.
      b. Finish Coats: Interior low-luster acrylic enamel.
   3. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Interior gypsum board primer.
      b. Finish Coats: Interior semigloss acrylic enamel.
   4. Gloss Epoxy Finish: Two finish coats over a primer.
      a. Primer: Interior gypsum board primer (wet areas).
      b. Finish Coats: Interior gloss epoxy.

I. Ferrous Metal: Provide the following finish systems over ferrous metal:
   1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Interior ferrous-metal primer.
      b. Finish Coats: Interior semigloss acrylic enamel.

J. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
   1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      a. Primer: Interior zinc-coated metal primer.
      b. Finish Coats: Interior semigloss acrylic enamel.

END OF SECTION

SECTION 11 53 23
REFRIGERATED COMPOSITE SAMPLER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Refrigerated Composite Sampler.

B. Include all labor, materials, equipment, transportation and services required to furnish and install the miscellaneous specialties shown on the drawings and herein specified.

1.2 RELATED SECTIONS

A. Technical Specifications Section 01

B. Section 01 65 00 – Commissioning of Systems

C. Section 01 73 00 – Installation, Operation and Maintenance Manuals

D. Division 26 – Electrical

E. Division 40 – Process Interconnections

1.3 SUBMITTALS

A. Submit product data per Section 01.

B. Submit shop drawings showing equipment dimensions, weights, materials of construction and assembly.

C. Closeout Submittals: Operations and Maintenance Manual: Provide Equipment Operation and Maintenance Manuals to the Owner per Section 01 73 00.

D. Provide written copies of manufacturer's warranties on products described in this specification section.

1.4 QUALITY ASSURANCE

A. Manufacturer: Company specializing in the manufacturing of the specified equipment, with a minimum of five (5) years documented experience.

1.5 WARRANTY

A. Equipment supplied under this section shall be warranted to be free from defects in workmanship, design, and materials for a period of one year from the date of Substantial Completion. If any part of the equipment should prove to be defective during the warranty period, the MANUFACTURER shall replace the part at no expense to the OWNER.

PART 2 PRODUCTS

2.1 REFRIGERATED COMPOSITE SAMPLER

A. Manufacturers: Provide refrigerated composite sampler meeting the requirements of this specification from one of the following manufacturers. Manufacturers meeting the requirements of this specification but not listed here may be considered in accordance with the Contract Documents and the Instructions to Bidders.

1. The WAVE™ as manufactured by Emerald Coast Manufacturing, Pensacola Florida 850-469-1142.

2. Engineer's pre-approved equal.

2.2 DESCRIPTION

A. The WAVE™ All-Climate cabinet shall be constructed of high impact and weatherable acrylic/abs body, fiberglass reinforced. All cabinet exterior surfaces shall be UV resistant. The sample containment door shall have a compressible gasket seal and positive mechanical latch. The controller and sample compartments shall be independently lockable. The sampler is suitable for use over a wide range of sampling applications with outstanding corrosion resistance. The refrigeration compartment shall be fully insulated and be able to maintain 4º C within the overall temperature range designed. The refrigeration module shall use 134A refrigerant and have a minimum 1/3 HP compressor with an evaporator fan to circulate the cabinet air. The refrigeration module shall be designed to slide in and out for easy replacement or repair. The cabinet shall be side vented for against the wall placement. All refrigeration lines are protected with phenolic resin coating. All refrigeration coils shall be equipped with an electrocoating system to provide superior corrosion protection. The evaporator coil shall receive an additional Fin-Kote 2 coating to enhance corrosion resistance in high-moisture environments. Cabinet ambient operating temperature range is -20º to 125º degrees F with heater. The inside cabinet temperature is adjusted and displayed on the touch screen. The average cabinet temperature will be shown on the display

B. The refrigerated sampler is suitable for composite sampling. The sampler shall use a single 5-gallon round LDPE polyethylene wide mouth container

C. The sampling system consists of a vacuum/pressure pump, valves integrally controlled by the sampler controller and an intermediate sampling chamber with non-contacting liquid sensor. Pre-purges and post purges are programmable from 1-140 seconds. Under program control, the sample line shall be purged before the sample is pulled through the sampling tube into the intermediate sampling chamber until the liquid is sensed and then the line will be purged again. The maximum vertical lift shall be 29 feet. The sample velocity shall be greater than 3.75 FPS @ 20 feet. The liquid sensor feature shall ensure that long horizontal runs will not affect sampler integrity or accuracy. The maximum horizontal run is 300 feet. Samplers utilizing peristaltic pumps will not be accepted.

D. The sampler shall be factory calibrated. This calibration shall be 7 different points within the range of 20 – 500 mL The calibration will not be affected by the tubing length, this calibration will be ± 3% of the first sample. A sample that requires field calibration and/or multiple samples to reach the correct sample size are not acceptable.

E. The sampler shall automatically adjust to the programmed sample size as programmed into the user interface.

F. The sampler shall utilize a non-contacting liquid sensing feed back to the controller to detect the presence of the liquid during the sample cycle. The liquid sensor is not affected by head height or tubing length. The sampler shall deliver a repeatable sample size, ± 1%. The sample size shall be programmable in one (1) mL increments from the touch screen. Samplers that count pump revolutions and program tubing information in the program is not acceptable.

G. The controller user interface shall consist of a 7" color multi-touch screen through which the user can enter data and scroll through various menus. The color multi-touch screen shall be a 1024 X 600-pixel, 1000 NIT, high-contrast backlit graphical LCD display. The user shall be able to use two fingers to enlarge the screen for easier viewing. The display shall use both text and graphics for user information. The user shall be supplied with a pass code protection feature by which unauthorized program changes and other controller administration features shall be locked against unauthorized access.

H. The sampler controller shall provide for automatic operation of up to eight sampler programs. The active sampling program shall be configurable for immediate start, delayed start, or time/date start. Delayed start shall allow for a preprogrammed delay of from 1 to 9999 minutes. The time/date feature shall prompt the user for entry of a real-time and calendar date at the time of each program initiation.

I. The sampler controller shall provide multiple features. The controller shall have the ability to pull a manual sample by touching manual on the screen without effecting the current programming. It shall have the ability to have weekly programming. It will be able to have a continuous or non-continuous option in the program.

J. A running program may be paused by a full container shut-off, a preprogrammed number of samples, a total elapsed run-time limit or manually. The full container shutoff shall consist of a float switch mounted inside the 5-gallon poly composite container.

K. The pre-programmed number of samples shall be a configurable feature of the active program.

L. The total elapsed time limit shall be a configurable parameter of the active program but shall base its time limits on the real-time clock within the sampler controller, independent of power losses during the active program time.

M. During program execution, samples shall be taken based on one of three programmable schedules: time, flow, or flow plus time. Timed sampling shall be based on either a fixed period in minutes or a random period. Flow sampling may be based on one of two input methods: pulses and 4-20 mA selectable under program control. Flow plus timed sampling shall allow for both timed and flow sampling systems to run concurrently with the first trigger resetting the other. A provision shall be made for flow sampling such that the user supplies flows in real-world units (gallons) without having to perform input source calculations. During program execution, a sample can be manually triggered without affecting the next scheduled sample.

N. The sampler controller shall incorporate a real-time clock with calendar functions, including leap-year. The real-time clock shall be guaranteed to run in the event of total power loss with an estimated life of ten years and shall be used to time-stamp archival records. This archive shall be a permanent record of significant sampling events including program start/stop, manual sampling, refrigeration temperature and each programmed sample acquisition. User shall be able to browse data directly from the touch screen without stopping the current running program.

O. The sampler controller shall be designed to preserve active running states in a non-volatile form during power outages. Program execution shall proceed as normal when power is resumed.

P. During the sampling cycle, the sample line shall be automatically air purged (1-140 sec) before and after each sample with the maximum of 20 PSI. The sample volume shall be programmable between 20-500 ml in 1 ml increments. The sample repeatability shall be nominally ± 1%. The sample strainer and lines shall have 3/8" opening and shall go through the sampling process without any restriction or size reductions.

Q. Data Logging: Time, Temperature(C), Type, Program, Source and Size.

R. Retries: Shall allow the user up to 4 attempts to collect a sample if no sample was detected. The feature is selectable from 0-4 attempts to obtain a sample. An alarm shall be tripped if the sample was unable to be pulled.

S. Rinse Cycle: Shall allow the user to precondition the intake line prior to sample acquisition. The cycles shall be user configurable to allow for varying sampling line lengths and conditions. Up to 4 rinses for each sample collection cycle.

T. Consecutive sampling feature shall be provided to allow the user to preprogram up to 24 consecutive samples for each single sampling event.

U. Alarm output shall be provided to supply a dry-contact relay closure to external equipment in the event of specific sampler controller conditions. The alarm will activate during any of the four conditions that exist. If the bottle is full, program ends and recycle activated, or temperature error.

V. The controller's electronics shall be protected in a totally sealed housing for corrosion and inclement weather. Electronics are located on top of the cabinet covered by a hinged lid. Circuit boards shall be conformal coated for protection from corrosion.

W. The unit shall operate from 115VAC 60 Hz power.

X. The sampling system may be optionally configured for the following three features: Quick Draw Sample, Auxiliary Sampling Output, and Contact Start

1. Quick draw sample allows an external input (Dry Contact) to trigger the sampler to pull an immediate sample.

2. Auxiliary sampling output shall be provided to supply a dry-contact relay closure to external equipment during any sampling cycle.

3. Contact Start input shall be provided to allow an external device to block or enable the sampling input (time, flow, or time + flow). The contact start input shall be further user configurable to be either an enable signal or a start signal. In the event of the enable signal configuration, the sampling input is enabled when the input is active and the internal controller counters are reset when the input is inactive. In the event of the start signal configuration, the sampling input is only blocked until the contact start input goes active for the first time

Y. Spare Parts shall be provided for routine maintenance and operation of sampler for the first two years of operation. Either the recommended schedule of maintenance per the O&M manual or actual historical experience, whichever is greater, will be used to calculate the required number of spare parts to be provided.

2.3 **ACCESSORIES**

A. Provide a non-mercury glass thermometer with a bottle filled with glass beads. Thermometer shall be Digi-Sense item # UX-08077-44.

B. Provide one stainless steel low-profile strainer

C. Provide 50 feet of 3/8” ID X 5/8” OD Heavy Wall PVC suction tubing

D. Provide a liquid level switch for bottle full option, comes with 5-gallon Nalgene bottle

PART 3 EXECUTION

3.1 INSTALLATION

A. Verify adjacent work is complete and ready to receive products.

B. Securely install products at locations shown on the drawings or as directed by the Owner.

C. Install electrical and controls in accordance with the manufacturer’s recommendations and the electrical division of these Technical Specifications.

END OF SECTION

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SECTION 14 30 00
MONORAIL

PART 1 GENERAL

1.1 DESCRIPTION

A. SCOPE

1. This section specifies a bridge crane, monorail, and hoisting equipment for the installation and removal of water treatment equipment.
2. Runway system must meet the requirements of Section 2.04.

B. CRANE SUMMARY

1. Monorail
    a. Location: Indoors, Normal Humidity, 40-110 degrees F operating temperature
    b. Span: See plan.
    c. Capacity: 1.5 Tons
    d. Crane type: Electric hoist and trolley
    e. Classification: Crane shall be designed and constructed to CMAA Specification #70 or #74, as applicable, for Class “C” service requirements and operation in a non-hazardous indoor environment.
    f. Crane speed: See plan.
    g. Crane drive: See plan.
    h. Trolley speed: See plan.
    i. Trolley drive: Motorized
    j. Hoist speeds: See plan.
    k. Hoist type: Electric wire rope
    l. Hoist lift required: 36’-0” ft
    m. Control: See plan.
    n. Options: Hand held radio remote control with spare transmitter

C. WORK INCLUDES THE FOLLOWING:

1. Detailed design of completed crane system, including bridge, end trucks, trolley, hoists, cabling, controls, and all appurtenances specified hereinafter.

2. Shop drawings.

3. Fabrication of a complete crane.

4. Inspection and shop testing.

5. Onsite load testing.

6. Documentation and schedules.

1.2 REFERENCES

A. OSHA Occupational Safety and Health Administration
Part 1926.554 - Overhead Hoists
Part 1910.179 – Overhead and Gantry Cranes

B. CMAA Crane Manufacturer's Association of America
Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes - No. 70 (2004)
Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist - No. 74 (2004)

C. ANSI / ASME:
American National Standards Institute /
American Society of Mechanical Engineers
ANSI / ASME HST-4 - 1999 Performance Standard For Overhead Electric Wire Rope Hoists
ANSI / ASME B30.16 – 2003 Overhead Hoists (Underhung)
ANSI / ASME B30.2 - 2001 Overhead and Gantry Cranes
(Top Running Bridge, Single Or Multiple Girder, Top Running Trolley Hoist)
ANSI / ASME B30.11 – 2004 Monorails and Underhung Cranes
ANSI / ASME B30.17 – 2003 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)

D. NEMA
National Electric Manufacturer's Association

E. NEC
National Electric Code – 1999
Article 100, Article 240-1, Article 430-31, Article 430-51, Article 610-1, Article 610-31

1.3 SUBMITTALS

A. SHOP DRAWINGS AND EQUIPMENT DATA

1. Manufacturer's catalog data for hoist.

2. Dimensional drawings and details for bridge crane system.

3. Wiring schematics. – ship with crane

B. OPERATIONS AND MAINTENANCE MANUALS (one set of Owner's manuals in paper and in digital format)

1. Equipment function, normal operating characteristics, and limiting conditions.

2. Assembly, installation, alignment, and maintenance instructions.

3. Lubrication and maintenance instructions.

4. Guide to “troubleshooting”.

5. Parts list.

6. As-built drawing.

7. Test results.

1.4 APPLICABLE STANDARDS

A. Contractor shall adhere to OSHA, state, and local safety guidelines, laws, rules, and regulations.

B. Contractor shall conform to all applicable ANSI, CMAA, and HMI specifications and/or standards.

C. Comply with CMAA specification 74 or 70, as applicable.

D. Long lead items [hoist, end trucks, drives and controls] will be ordered by contractor upon receipt of purchase order and credit approval. Steel will not be ordered until shop drawings and submittals have been approved by the customer.

E. All electric equipment shall be UL, CSA c/us or ETL labeled.

1.5 WARRANTIES

A. Provide one-year equipment warranty.

PART 2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS

A. Materials and equipment shall be standard products of manufactures regularly engaged in the fabrication, Sales and Service of overhead cranes and shall have been in business for a minimum of 10 years prior to bid opening.

B. Manufacturers

1. HOJ Innovations
2. Dearborn Overhead Crane
3. Or Approved Equal

C. ‘Approved Equals’ will be accepted in accordance with Instructions to Bidders Article 11.

D. Hoist shall be electric wire rope type as described in these specifications.

2.2 MATERIALS

Components	Material
Bridge beams	Steel, ASTM A992
End trucks	Steel, ASTM A36 (or equal)
Trolley	Steel, ASTM A36 (or equal)
Wheels	Cast iron or steel
Hooks	Forged steel

2.3 EQUIPMENT

A. HOIST AND TROLLEY

1. Top-running and under-running single girder cranes shall utilize the low headroom or standard headroom electric wire rope hoists

2. Top-running double girder cranes shall utilize double girder trolley electric wire rope hoists

3. The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110% of the rated load.

4. Hoist and trolley motors shall be per 1.1B above, as applicable.

5. Hoisting motor(s) shall be two-speed/two winding squirrel cage type with a speed ratio of 6:1.

6. Hoisting motor(s) shall be totally enclosed with IP55 protection, minimum class F insulation, Klixon type bimetal switch for thermal protection and shall have a 60% ED rating.

7. Trolley shall be furnished with an adjustable frequency inverter drive and two-step or infinitely variable speed control for smooth acceleration and deceleration.

8. Trolley motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV [totally enclosed non-ventilated].

9. Rotary cam type limit switch equipped with 4 micro-switches shall be provided. Limit switch shall provide upper and lower limit of hoist travel, hoist slow down prior to reaching upper limit and phase sequence supervision at upper limit. An additional block operated limit shall be included.

10. Hoist motor brake shall be DC disc type with adequate torque to stop and hold over 125% of the hoist rated load.

11. Large diameter rope drum with a minimum of 36:1 drum to wire rope diameter ratio. Groove depth shall be at least 35% of rope diameter. The rope drum shall be equipped with a rope guide to help keep the rope aligned in the grooves of the drum.

12. Wire rope shall be constructed from galvanized steel having a minimum safety factor of 5.

13. Hoist reeving shall be single reeved. Lateral hook drift shall not exceed 1/8 inch per foot of vertical travel on single reeved models.

14. The hoist nameplate is to carry a CSA c/us rating. The actual hoist control enclosure rating shall be at least equivalent to IP55 / NEMA 4 type.

15. Hooks shall be made of forged alloy steel (34CrMo4QT or 34CrNiMo6QT) and shall be fitted with a spring-loaded flipper-type safety latch.

16. Hoist shall have a duty rating suitable for the load class and load cycles of the application.

17. AGMA quality class 12 machine cut, hardened and precision ground hoist gearing. The gears inside the hoist gearboxes on models up to 5 ton capacity are lubricated by semi-fluid grease. On models over 5 ton capacity the gears inside the hoist gearbox are lubricated with semi-fluid grease or oil.

18. AGMA quality class 10, hardened and precision ground trolley drive gearing, lubricated by semi-fluid grease.

19. Trolleys shall have safety drop lugs and energy absorbing bumpers.

B. BRIDGE GIRDER

1. Bridge girder shall be per 1.01B above, as applicable.

2. Bridge girders shall be constructed from welded box girders or Structural beams, Steel, ASTM A992, as required.

C. END TRUCKS AND BRIDGE DRIVE

1. End trucks shall be designed in accordance with CMAA specifications as applicable.

2. End trucks shall be bolted to bridge girder.

3. Bridge drive shall be dual-motor (A-4 arrangement per CMAA).

4. Bridge drive shall be designed to stop the bridge within CMAA specifications.

5. End trucks shall be equipped with rail sweeps and energy-absorbing rubber bumpers.

6. Travel limit switches to be provided as necessary for safe operation.

7. Bridge shall be furnished with an adjustable frequency inverter drive and two-step or infinitely variable speed control for smooth acceleration and deceleration.

8. Bridge motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV [totally enclosed non-ventilated].

9. AGMA quality class 10, hardened and precision ground bridge drive gearing, lubricated by semi-fluid grease.

D. POWER SUPPLY

1. Power supply for the hoist shall be 460 volt, 3 ph., 60 Hz. All power required for the operation of the hoist, trolley, and end trucks shall be developed from this source.

2. Runway electrification shall be 4-bar safety type rigid conductors as manufactured by Insul-8, Duct-O-Wire Company or Wampfler and designed for crane load. Wall mounted disconnect switch and power to runway conductors provided by Electrical Contractor.

3. Cross bridge electrification shall be flat cable style festoon system with terminal box, multi-conductor cord, plug connectors (when available) and accessories. Cables are to be hardwired when plug connectors are not available.

E. CONTROLS

The following controls shall be included as part of the crane system:

1. Six-way operation, plug-in pushbutton pendant suspended from independent festoon track.

2. Hand held radio remote control unit with spare transmitter.

3. Pendant shall include Start (momentary) button and Emergency Stop (push to maintain, turn to release) that controls a mainline contactor in the bridge control panel.

4. Pushbutton shall be clearly marked with hoist, trolley and bridge travel directions.

5. Hoist shall be 2 speed magnetic reversing type (standard) and the trolley and bridge controls shall be variable frequency inverter control (standard), as required per Section 1.1B.

6. Electrical control enclosures shall be IP55 or NEMA 4 type. Pushbutton enclosure shall have a rating of IP65, NEMA 4X, 4 or 5.

7. Warning device Horn or Light required

F. LABELING

1. Hoist and bridge beam shall be permanently labeled with load rating.

2. A corrosion-resistant nameplate shall be fixed to the bridge with the following information:

a. Name of manufacturer
b. Mfg.'s model number and serial number
c. Capacity
d. Date of manufacture (month and year)

G. PAINTING

1. Hoist and trolley shall be factory painted (2-part epoxy) per manufacturer's standards.

2. Bridge shall be shop cleaned, primed, and painted per manufacturer's standards.

3. The following items shall not be painted:

a. Rail surfaces in contact with wheels
b. Wheel running surfaces
c. Hoist wire rope
d. Conductor bar, festoon cables and supports

2.4 RUNWAY SYSTEM

1. Design runway system in accordance with local codes, AISC and CMAA standards.

2. Furnish and install runway system with columns and column supports per the plans.

3. Furnish and install ASCE rail system complete with hardware and attachment bolts.

4. Furnish and install 4 bar runway electrification sized for the crane loads.

5. Wall mounted disconnect switch and power to runway conductors shall be furnished and installed by Electrical contractor.

PART 3 EXECUTION

3.1 INSTALLATION AND INSPECTION

A. Inspect runway structure and crane rail erection for conformance with reviewed shop drawings, contract documents and CMAA specifications prior to installation of equipment. Bring nonconforming work to the attention of Owner prior to proceeding with crane installation. Non-conforming runway structure or installation must be corrected prior to load testing of crane system. Costs of delays or additional work due to nonconforming runway structure will be the responsibility of the Contractor.

B. Bridge crane shall be installed in conformance with manufacturer's instructions and inspected by a manufacturer's representative. Provide all necessary accessories to make bridge crane complete, usable, and capable of meeting the operating requirements specified in the Operating Requirements. Test, adjust and clean equipment for acceptance by Owner.

3.2 TESTING

A. All crane equipment shall be operated through a complete lift and lowering cycle and through a complete travel of the bridge and trolley to determine that the equipment shall perform smoothly and safely and that pendant cable length is sufficient to permit operation from desired floor levels. All tests shall be carried out with the bridge crane equipment loaded at 125 percent of capacity. The Owner shall provide the test weight loads. Any defects shall be corrected by the bridge crane provider without any expense to the Owner.

B. Inspection / start-up and load test sheets provided to Owner or representative after completion.

3.3 USE BY CONTRACTOR

A. Crane shall not be used by Contractor unless authorized by Owner. If crane is used by the Contractor, it shall be repaired, repainted, and otherwise refurbished to like new condition prior to its acceptance. The Contractor assumes all responsibility for operation and maintenance until the crane has been accepted by Owner.

3.4 CLEANUP

A. Upon completion of work, area shall be cleaned and restored to original condition, acceptable to the Owner.

END OF SECTION

SECTION 220513
COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

E. Electronically Commutated Motors (ECM).

1.02 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators; 2018.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

D. Operation Data: Include instructions for safe operating procedures.

E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.05 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.

B. Leeson Electric Corporation: www.leeson.com/#sle.

C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com/#sle.

D. Substitutions: See Section 016000 - Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

B. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Single phase motors for shaft mounted fans, oil burners, and centrifugal pumps: Split phase type.

C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

D. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.

E. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.

F. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

G. Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.

H. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Manufacturers:
   1. US Motors, a brand of NIDEC Motor Corporation: www.usmotors.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 220516
EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flexible pipe connectors.

B. Expansion joints and compensators.

C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

A. Section 221005 - Plumbing Piping.

1.03 REFERENCE STANDARDS

A. EJMA (STDS) - EJMA Standards; Tenth Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data:
   1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
   2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.

D. Maintenance Data: Include adjustment instructions.

E. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Packing for Packed Expansion Joints: One set for each joint.

PART 2 PRODUCTS

2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Manufacturers:
   1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
   2. The Metraflex Company: www.metraflex.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Inner Hose: Carbon steel.

C. Exterior Sleeve: Single braided, stainless steel.

D. Exterior Sleeve: None.

E. Pressure Rating: 125 psi and 450 degrees F.

F. Joint: Flanged.

G. Size: Use pipe sized units.

H. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Manufacturers:

1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
2. The Metraflex Company: www.metraflex.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Inner Hose: Bronze.

C. Exterior Sleeve: Braided bronze.

D. Pressure Rating: 125 psi and 450 degrees F.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Maximum offset: 3/4 inch on each side of installed center line.

H. Application: Copper piping.

2.03 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

A. Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
2. The Metraflex Company: www.metraflex.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Pressure Rating: 125 psi and 400 degrees F.

C. Maximum Compression: 1-3/4 inches.

D. Maximum Extension: 1/4 inch.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Application: Steel piping 4 inches and under.

2.04 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

A. Manufacturers:
1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
2. The Metraflex Company: www.metraflex.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Construction: Bronze with anti-torque device, limit stops, internal guides.

C. Pressure Rating: 125 psi and 400 degrees F.

D. Maximum Compression: 1-3/4 inches.

E. Maximum Extension: 1/4 inch.

F. Joint: Soldered.

G. Size: Use pipe sized units.

H. Application: Copper piping.

2.05 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

A. Manufacturers:
1. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support bracket and air release or drain plug.

C. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.

D. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
   1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
   2. Accommodate the Following:
      a. Axial Deflection in Compression and Expansion: 1 inch.
      b. Lateral Movement: 1 inch.
      c. Angular Rotation: 15 degrees.
      d. Force developed by 1.5 times specified maximum allowable operating pressure.
   3. End Connections: Same as specified for pipe jointing.
   4. Provide necessary accessories including, but not limited to, swivel joints.

2.06 ACCESSORIES

A. Pipe Alignment Guides:
   1. Manufacturers:
      a. The Metraflex Company; PGQ Glide Riser Guide: www.metraflex.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

B. Swivel Joints:
   1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.

C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION

SECTION 220517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.02 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Manufacturers:
   1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.

C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

D. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc coated or cast iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

F. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the Architect.

G. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
   2. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.
   3. Elastomer element size and material in accordance with manufacturer's recommendations.
   4. Glass reinforced plastic pressure end plates.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   3. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

E. Structural Considerations:
   1. Do not penetrate building structural members unless indicated.

F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
   2. Aboveground Piping:
      a. Pack solid using mineral fiber complying with ASTM C592.

b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.

3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

G. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
3. Locate piping in center of sleeve or penetration.
4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION

SECTION 220519
METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Positive displacement meters.

B. Flow meters.

C. Pressure gauges and pressure gauge taps.

D. Thermometers and thermometer wells.

E. Static pressure gauges.

F. Filter gauges.

1.02 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.

B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).

C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).

E. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.

F. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2015.

G. AWWA C702 - Cold-Water Meters -- Compound Type; 2015.

H. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).

I. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

J. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Gauge Oil for Inclined Manometers: One bottle.
   2. Extra Pressure Gauges: One of each type and size.

1.04 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. FMC Technologies: www.fmctechnologies.com/#sle.

3. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. AWWA C700, positive displacement disc type suitable for fluid with bronze case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading.

C. Meter: Brass body turbine meter with magnetic drive register.

2.02 HEAT CONSUMPTION METERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. FMC Technologies: www.fmctechnologies.com/#sle.
3. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Meter: Brass body turbine meter with magnetic drive register, platinum temperature sensors.

2.03 LIQUID FLOW METERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Venture Measurement, a Danaher Corporation Company: www.venturemeasurement.com/#sle.
3. McCrometer, Inc: www.mccrometer.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Calibrated ASME MFC-3M venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

C. Annular element flow stations with meter set.
1. Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
2. Portable Meter Set: Dry single diaphragm type pressure gauge with 6 inch dial pointer, stainless steel wetted metal parts, variable pulsation damper, equalizing valve, two bleed valves, and master chart for direct conversion of meter readings to flow rate, mounted in rust-proof carrying case with two ten foot long rubber test hoses with brass valves or quick connections for measuring stations.

2.04 PRESSURE GAUGES

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
3. Omega Engineering, Inc: www.omega.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi and kPa.

2.05 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.06 STEM TYPE THERMOMETERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. Omega Engineering, Inc: www.omega.com/#sle.
   3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
   1. Size: 9 inch scale.
   2. Window: Clear Lexan.
   3. Accuracy: 2 percent, per ASTM E77.
   4. Calibration: Degrees F.

C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9 inch scale.
   2. Window: Clear Lexan.
   3. Stem: 3/4 inch NPT brass.
   4. Accuracy: 2 percent, per ASTM E77.
   5. Calibration: Degrees F.

2.07 DIAL THERMOMETERS

A. Manufacturers:
   1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
   2. Omega Engineering, Inc: www.omega.com/#sle.
   3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
   1. Size: 5 inch diameter dial.
   2. Lens: Clear glass.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.

C. Thermometers - Adjustable Angle: Dial type bimetallic actuated; ASTM E1; stainless steel case, adjustable angle with front recalibration, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
   1. Size: 5 inch diameter dial.
   2. Lens: Clear glass.
   3. Accuracy: 1 percent.
   4. Calibration: Degrees F.

D. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer,

glass lens.

1. Size: 4-1/2 inch diameter dial.
2. Lens: Clear glass.
3. Length of Capillary: Minimum 5 feet.
4. Accuracy: 2 percent.
5. Calibration: Degrees F.

2.08 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.09 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

B. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

C. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Viton core for temperatures up to 400 degrees F.

D. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gauges, one gauge adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.10 STATIC PRESSURE GAUGES

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Omega Engineering, Inc: www.omega.com/#sle.
3. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. 3-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

C. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

D. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.

C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

D. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation. Provide siphon on gauges in steam systems.

E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

F. Install thermometers in air duct systems on flanges.

G. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 230943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.

H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.

I. Coil and conceal excess capillary on remote element instruments.

J. Provide instruments with scale ranges selected according to service with largest appropriate scale.

K. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

L. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

M. Locate test plugs adjacent thermometers and thermometer sockets.

3.02 SCHEDULES

A. Positive Displacement Meters, Location:
   1. Condensate return.
   2. Domestic cold water.
   3. Expansion tank make-up.
   4. Cooling tower make-up.

B. Flow Meters, Location:
   1. Heating water system.
   2. Condensate water system.
   3. Chilled water system.

C. Pressure Gauges, Location and Scale Range:

D. Pressure Gauge Tappings, Location:
   1. Control valves 3/4 inch & larger - inlets and outlets.
   2. Major coils - inlets and outlets.
   3. Heat exchangers - inlets and outlets.
   4. Chiller - inlets and outlets.
   5. Boiler - inlets and outlets.

E. Stem Type Thermometers, Location and Scale Range:

F. Thermometer Sockets, Location:
   1. Control valves 1 inch & larger - inlets and outlets.
   2. Reheat coils - inlets and outlets.
   3. Cabinet heaters - inlets and outlets.
   4. Unit heaters - inlets and outlets.

G. Dial Thermometers, Location and Scale Range:

H. Static Pressure and Filter Gauges, Location and Scale Range:

END OF SECTION

SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.
B. Angle valves.
C. Ball valves.
D. Butterfly valves.
E. Check valves.
F. Gate valves.
G. Globe valves.
H. Plug valves.
I. Chainwheels.

1.02 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Non-rising stem.
E. OS&Y: Outside screw and yoke.
F. PTFE: Polytetrafluoroethylene.
G. RS: Rising stem.
H. WOG: Water, oil, and gas.

1.03 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013 (Reaffirmed 2018).
B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.
E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.
F. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.
G. ASME B31.9 - Building Services Piping; 2020.
H. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).
I. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).
J. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2019)e1.
K. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015.
L. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
M. AWWA C606 - Grooved and Shouldered Joints; 2015.
N. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).

O. MSS SP-67 - Butterfly Valves; 2017.

P. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.

Q. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2018.

R. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.

S. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

T. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

U. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.

V. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

W. NSF 61 - Drinking Water System Components - Health Effects; 2020.

X. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.05 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

A. Handle large valves with sling, modified to avoid damage to exposed parts.

B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See drawings for specific valve locations.

B. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, .
   2. Dead-End: Single-flange butterfly (lug) type.
   3. Throttling: Provide .
   4. Swing Check (Pump Outlet):
      a. 2 NPS and Smaller: Bronze swing check valves with disc.
      b. 2-1/2 NPS and Larger for Domestic Water: Iron swing check valves with closure control, seat check valves.
      c. 2-1/2 NPS and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

C. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

D. Required Valve End Connections for Non-Wafer Types:
   1. Steel Pipe:
      a. 2 NPS and Smaller: Threaded ends.

b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
c. 5 NPS and Larger: Grooved or flanged ends.
d. Grooved-End : Grooved.

2. Copper Tube:
a. 2 NPS and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
b. 2-1/2 NPS to 4 NPS: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
c. 5 NPS and Larger: Grooved or flanged ends.

E. Low Pressure, Compressed Air Valves 150 psig or Less:
1. 2 NPS and Smaller:
a. Bronze: Provide with ends.
b. Ball: One piece, full port, with brass trim.
c. Bronze Lift Check: Class 125, bronze disc.
d. Bronze Swing Check: Class 125, bronze disc.
e. Bronze Gate: Class 125, NRS.

2. 2-1/2 NPS and Larger:
a. Iron, 2-1/2 NPS to 4 NPS: Provide with ends.
b. Iron Single-Flange Butterfly: 200 CWP, NBR Seat, aluminum-bronze disc.
c. Iron Grooved-End Butterfly: 175 CWP.
d. Iron Swing Check: Class 125, metal seats.
e. Iron Grooved-End Swing Check: 300 CWP.
f. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
g. Iron Plate-Type Check: Class 125; single plate; metal seat.
h. Iron Gate: Class 125, NRS.

F. Domestic, Hot and Cold Water Valves:
1. 2 NPS and Smaller:
a. Bronze and Brass: Provide with ends.
b. Bronze Angle: Class 125, bronze disc.
c. Ball: One piece, full port, with brass trim.
d. Bronze Swing Check: Class 125, bronze disc.
e. Bronze Gate: Class 125, NRS.
f. Bronze Globe: Class 125, bronze disc.

2. 2-1/2 NPS and Larger:
a. Iron, 2-1/2 NPS to 4 NPS: Provide with ends.
b. Iron Ball: Class 150.
c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
d. Iron Grooved-End Butterfly: 175 CWP.
e. Iron Swing Check: Class 125, metal seats.
f. Iron Swing Check with Closure Control: Class 125, lever and spring.
g. Iron Grooved-End Swing Check: 300 CWP.
h. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
i. Iron Plate-Type Check: Class 125; single plate; metal seat.
j. Iron Gate: Class 125, NRS.
k. Iron Globe: Class 125.

G. Sanitary Waste Water Valves:
1. 2-1/2 NPS and Larger:
a. Iron, 2-1/2 NPS to 4 NPS: Provide with ends.

b. Iron Ball: Class 150.
c. Iron Swing Check: Class 125, metal seats.
d. Iron Swing Check with Closure Control: Class 125, lever and spring.
e. Iron Grooved-End Swing Check: 300 CWP.
f. Iron Gate: Class 125, NRS.
g. Iron Globe: Class 125.
h. Lubricated Plug: Class 125, regular gland.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
2. Handwheel: Valves other than quarter-turn types.
3. Hand Lever: Quarter-turn valves 6 NPS and smaller except plug valves.
4. Wrench: Plug valves with square heads.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: With 2 NPS stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.

E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Pipe Flanges and Flanged Fittings 1/2 NPS through 24 NPS: ASME B16.5.
4. Solder Joint Connections: ASME B16.18.
5. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Valve Bypass and Drain Connections: MSS SP-45.

I. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

A. Class 125: CWP Rating: 200 psig.
1. Comply with MSS SP-80, Type 1.
2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
3. Ends: Threaded.
4. Stem: Bronze.

5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Bronze or aluminum.

2.04 BRASS, BALL VALVES

A. One-Piece, Reduced-Port with Brass Trim:
1. Comply with MSS SP-110.
2. Body: Forged brass.
3. Ends: Threaded.
4. Seats: PTFE.
5. Stem: Brass.
6. Ball: Chrome-plated brass.

B. Two Piece, Full Port with Brass Trim and Threaded Connections:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig, WOG.
4. Body: Forged brass.
5. Seats: PTFE.
6. Stem: Brass.
7. Ball: Chrome-plated brass.

C. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged brass.
5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.

2.05 BRONZE, BALL VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. One Piece, Reduced Port with Bronze Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 400 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Press.
6. Seats: PTFE.
7. Stem: Bronze.
8. Ball: Chrome plated brass.

C. Two Piece, Full Port with Bronze Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends: Threaded.
6. Seats: PTFE.

7. Stem: Bronze.
8. Ball: Chrome plated brass.

D. Three Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body: Bronze.
5. Ends: Threaded or press.
6. Seats: PTFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.

2.06 IRON, BALL VALVES

A. Class 125, Full Port, Stainless Steel Trim:
1. Comply with MSS SP-72.
2. CWP Rating: 200 psig.
3. Body: ASTM A536 Grade 65-45-12, ductile iron.
4. Ends: Flanged.
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.
8. Operator: Lever, with locking handle.
9. Manufacturers:
a. Apollo Valves: www.apollovalves.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

2.07 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style: Bi-directional dead-end service without use of downstream flange.
1. Comply with MSS SP-67, Type I.
2. CWP Rating: 200 psig.
3. Body: ASTM A126, cast iron or ASTM A536, ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: EPDM.
6. Disc: Stainless steel.
7. Manufacturers:
a. Apollo Valves: www.apollovalves.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.

2.08 IRON, GROOVED-END BUTTERFLY VALVES

A. CWP Rating: 175 psig (1200 kPa).
1. Comply with MSS SP-67, Type I.
2. Body: Coated ductile iron.
3. Stem: Two-piece stainless steel.
4. Disc: Coated ductile iron.
5. Disc Seal: EPDM.

2.09 BRONZE, LIFT CHECK VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
2. CWP Rating: 200 psig.
3. Design: Vertical flow.
4. Body: Comply with ASTM B61 or ASTM B62, bronze.
5. Ends: Threaded as indicated.
6. Disc (Type 1): Bronze.

2.10 BRONZE, SWING CHECK VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125 CWP Rating; 200 psig (1,380 kPa) WOG:
1. Comply with MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. Body: Bronze, ASTM B62.
4. Ends: Threaded.
5. Disc: Bronze.

2.11 IRON, HORIZONTAL SWING CHECK VALVES

A. Class 125:
1. Comply with MSS SP-71, Type I.
2. CWP Rating: 200 psig.
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray cast iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Composition.
7. Seat Ring and Disc Holder: Bronze.
8. Disc: PTFE.
9. Gasket: Asbestos free.

2.12 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125 with Lever and Spring-Closure Control.
1. Comply with MSS SP-71, Type I.
2. Description:
a. CWP Rating: 200 psig.
b. Design: Clear or full waterway.
c. Body: ASTM A126, gray iron with bolted bonnet.
d. Ends: Flanged as indicated.
e. Trim: Bronze.
f. Gasket: Asbestos free.
g. Closer Control: Factory installed, exterior lever, and weight.

2.13 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP:
1. CWP Rating: 300 psig.
2. Body: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM.
4. Disc: Ductile iron.
5. Coating: Black, non-lead paint.

2.14 BRONZE, GATE VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. NRS (Non-rising Stem) or OS & Y (Rising Stem):
   1. Comply with MSS SP-80, Type I.
   2. Class 125: CWP Rating 200 psig.
   3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
   4. Ends: Threaded or solder joint joint.
   5. Stem: Bronze.
   6. Disc: Solid wedge; bronze.
   7. Packing: Asbestos free.
   8. Handwheel: Malleable iron, bronze, or aluminum.

2.15 IRON, GATE VALVES

A. Bolted Bonnet: OS&Y (Rising Stem):
   1. Comply with MSS SP-70, Type I.
   2. Class 125: CWP Rating: 200 psig.
   3. Body: ASTM A126, gray iron with bolted bonnet.
   4. Ends: Flanged.
   5. Trim: Bronze.
   6. Disc: Solid wedge.
   7. Packing and Gasket: Asbestos free.

2.16 BRONZE, GLOBE VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125: CWP Rating 200 psig:
   1. Comply with MSS SP-80, Type 1.
   2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
   3. Ends: Threaded joint.
   4. Stem: Bronze.
   5. Disc: PTFE.
   6. Packing: Asbestos free.
   7. Handwheel: Malleable Iron.

2.17 IRON, GLOBE VALVES

A. Class 125: CWP Rating: 200 psig:.
   1. Comply with MSS SP-85, Type I.
   2. Body: Gray iron; ASTM A126, with bolted bonnet.
   3. Ends: Flanged.
   4. Trim: Bronze.
   5. Packing and Gasket: Asbestos free.
   6. Operator: Handwheel or chainwheel.

2.18 LUBRICATED PLUG VALVES

A. Regular Gland with Flanged Ends:
   1. Comply with MSS SP-78, Type II.
   2. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
   3. Pattern: Regular or short.
   4. Plug: Cast iron or bronze with sealant groove.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

D. Install check valves where necessary to maintain direction of flow as follows:
   1. Lift Check: Install with stem plumb and vertical.
   2. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
   1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with MSS SP-58.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 4. Include consideration for vibration, equipment operation, and shock loads where applicable.

5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:
1. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Thomas & Betts Corporation: www.tnb.com/#sle.
    c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
    d. Substitutions: See Section 016000 - Product Requirements.
2. Comply with MFMA-4.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
    a. Equipment Supports: 1/2 inch diameter.
    b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
    c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
    d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

D. Thermal Insulated Pipe Supports:
1. Manufacturers:
    a. KB Enterprises: www.snappitz.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.
2. General Construction and Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
    d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
3. PVC Jacket:
    a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
    b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    c. Thickness: 60 mil.
4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

E. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Erico International Corporation, a brand of Pentair: www.erico.com/#sle.
    c. PHP Systems/Design: www.phpsd.com/#sle.

d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
e. Substitutions: See Section 016000 - Product Requirements.

2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 220548
VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.
   1. Includes requirements for seismic qualification of equipment not specified in this section.

C. Vibration-isolated equipment support bases.

D. Vibration isolators.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete.

1.03 DEFINITIONS

A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
2. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Vibration Isolation Systems:
1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Shop Drawings - Seismic Controls:
1. Include dimensioned plan views and sections indicating proposed plumbing component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
3. Indicate proposed arrangement of distributed system trapeze support groupings.
4. Indicate proposed locations for distributed system flexible fittings and/or connections.
5. Indicate locations of seismic separations where applicable.

F. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed plumbing components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
a. Component operating weight and center of gravity.
b. Component elevation in the building in relation to the roof elevation (z/h).
c. Component importance factor (Ip).
d. For distributed systems, component materials and connection methods.
e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).

G. Certification for seismically qualified equipment; identify basis for certification.

H. Evidence of qualifications for seismic controls designer.

I. Evidence of qualifications for manufacturer.

1.07 QUALITY ASSURANCE

A. Comply with applicable building code.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
1. Select vibration isolators to provide required static deflection.
2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.

D. Equipment Isolation: As indicated on drawings.

E. Piping Isolation:
   1. Provide vibration isolators for piping supports:
      a. Located in equipment rooms.
      b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
      c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.
   2. Minimum Static Deflection:
      a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
      b. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
   3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
   4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
   5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
   6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
   7. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
   1. Vibration-Isolated Equipment Support Bases:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.
   2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Vibration-Isolated Concrete Inertia Bases:
   1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
   2. Minimum Base Depth: 6 inches.
   3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
   4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
   5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.

2.03 VIBRATION ISOLATORS

A. Manufacturers:
   1. Vibration Isolators:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

B. General Requirements:
   1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:
   1. Vibration-Isolated Equipment Support Bases:
      a. Provide specified minimum clearance beneath base.
   2. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
   3. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
   4. Adjust isolators to be free of isolation short circuits during normal operation.
   5. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Vibration Isolation Systems:
   1. Verify isolator static deflections.
   2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Air Terminal Units: Tags.

C. Automatic Controls: Tags. Key to control schematic.

D. Control Panels: Nameplates.

E. Dampers: Ceiling tacks, where located above lay-in ceiling.

F. Ductwork: Nameplates.

G. Heat Transfer Equipment: Nameplates.

H. Instrumentation: Tags.

I. Major Control Components: Nameplates.

J. Piping: Tags.

K. Pumps: Nameplates.

L. Relays: Tags.

M. Small-sized Equipment: Tags.

N. Tanks: Nameplates.

O. Thermostats: Nameplates.

P. Valves: Tags and ceiling tacks where located above lay-in ceiling.

Q. Water Treatment Devices: Nameplates.

2.02 NAMEPLATES

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com/#sle.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
3. Seton Identification Products: www.seton.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Laminated three-layer plastic with engraved letters.
1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Plastic: Comply with ASTM D709.

2.03 TAGS

A. Manufacturers:
1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
2. Brady Corporation: www.bradycorp.com/#sle.
3. Brimar Industries, Inc: www.pipemarker.com/#sle.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
5. Seton Identification Products: www.seton.com/#sle.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 PIPE MARKERS

A. Manufacturers:
1. Brady Corporation: www.bradycorp.com/#sle.
2. Brimar Industries, Inc: www.pipemarker.com/#sle.
3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
4. Seton Identification Products: www.seton.com/#sle.
5. Substitutions: See Section 016000 - Product Requirements.

B. Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

F. Color code as follows:
1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
2. Fire Quenching Fluids: Red with white letters.
3. Toxic and Corrosive Fluids: Orange with black letters.
4. Flammable Fluids: Yellow with black letters.
5. Combustible Fluids: Brown with white letters.
6. Compressed Air: Blue with white letters.

2.05 CEILING TACKS

A. Manufacturers:
1. Craftmark: www.craftmarkid.com/#sle.

2. Substitutions: See Section 016000 - Product Requirements.

B. Description: Steel with 3/4 inch diameter color coded head.

C. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Plumbing Valves: Green.
   4. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Install plastic pipe markers in accordance with manufacturer's instructions.

D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Use tags on piping 3/4 inch diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet 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.

G. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

H. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 220716
PLUMBING EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment insulation.

B. Flexible removable and reusable blanket insulation.

C. Covering.

D. Breeching insulation.

1.02 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

E. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2021.

F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

G. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

H. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.05 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
   4. Owens Corning Corp: www.owenscorning.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible.
   1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.

C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

2.03 GLASS FIBER, RIGID

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com/#sle.
   4. Owens Corning Corp: www.owenscorning.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
   1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.
   4. Maximum Density: 8.0 lb/cu ft.

C. Vapor Barrier Jacket:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

D. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

2.04 CELLULAR GLASS

A. Manufacturers:
   1. Pittsburgh Corning Corporation: www.foamglasinsulation.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Pipe and Tube Insulation: ASTM C552, Type II, Grade 6.
   1. K Value: 0.35 at 100 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Service Temperature Range: From 250 degrees F to 800 degrees F.
   3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
   4. Water Absorption: 0.5 percent by volume, maximum.
   5. Density: A minimum of 6.12 lb/cu ft.

2.05 JACKETS

A. PVC Plastic:

1. Manufacturers:
    a. Johns Manville Corporation: www.jm.com/#sle.
    b. Substitutions: See Section 016000 - Product Requirements.
2. Jacket: Sheet material, off-white color.
    a. Minimum Service Temperature: Minus 40 degrees F.
    b. Maximum Service Temperature: 150 degrees F.
    c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
    d. Thickness: 10 mil.
    e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

G. For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.

H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

J. Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

K. Inserts and Shields:
1. Application: Equipment 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between hangers and inserts.
3. Insert location: Between support shield and equipment and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

L. Finish insulation at supports, protrusions, and interruptions.

M. Exterior Applications:
   1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
   2. Cover with aluminum, stainless steel, or _____.

N. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

P. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

END OF SECTION

SECTION 220719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2020a.

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

F. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2021.

G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: www.knaufinsulation.com/#sle.

4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: www.ocbuildingspec.com/#sle.
5. Owens Corning Corporation; VaporWick Pipe Insulation: www.ocbuildingspec.com/#sle.
6. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Blanket: 1.0 lb/cu ft density.
3. Weave: 5 by 5.

E. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

2.03 CELLULAR GLASS

A. Manufacturers:
1. Pittsburgh Corning Corporation: www.foamglasinsulation.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature Range: From 250 degrees F to 800 degrees F.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:
1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
2. Armacell LLC; AP Armaflex: www.armacell.us/#sle.
3. K-Flex USA LLC; Insul-Tube: www.kflexusa.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

2.05 JACKETS

A. PVC Plastic.
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.

c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.

3. Covering Adhesive Mastic: Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
1. Thickness: 0.016 inch sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

J. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced

vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

K. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

L. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

A. Plumbing Systems:
   1. Domestic Hot Water Supply:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: 1-1/4" and less.
         2) Thickness: 1-1/2".
         3) Pipe Size Range: 1-1/2" and larger.
         4) Thickness: 2".
   2. Domestic Hot Water Recirculation:
      a. Glass Fiber Insulation:
         1) Pipe Size Range: 1-1/4" and less.
         2) Thickness: 1-1/2".
         3) Pipe Size Range: 1-1/2" and larger.
         4) Thickness: 2"
   3. Tempered Domestic Water Supply: 1-1/2"
   4. Tempered Domestic Water Recirculation: 1-1/2"
   5. Domestic Cold Water: 1/2"
   6. Roof Drain Bodies: 1/2"
   7. Roof Drainage Above Grade: 1/2"
   8. Roof Drainage Within 10 Feet of the Exterior: 1/2"
   9. Roof Drainage Run Horizontal at Roof Level: 1/2"
   10. Plumbing Vents Within 10 Feet of the Exterior:

B. Heating Systems:
   1. Heating Water Supply and Return: 2"
   2. Glycol Heating Supply and Return: 2"

C. Cooling Systems:
   1. Chilled Water: 1-1/2"

D. Other Systems: 1/2"

END OF SECTION

SECTION 221005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Chemical resistant sewer.
   3. Domestic water.
   4. Storm water.
   5. Flanges, unions, and couplings.
   6. Pipe hangers and supports.
   7. Manufactured sleeve-seal systems.
   8. Ball valves.
   9. Butterfly valves.
   10. Balancing valves.
   11. Pressure reducing valves.
   12. Relief valves.
   13. Strainers.

1.02 RELATED REQUIREMENTS

A. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.

1.03 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 2015.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

F. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; 2016.

G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; 2017.

H. ASME B31.1 - Power Piping; 2020.

I. ASME B31.9 - Building Services Piping; 2020.

J. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2019.

K. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.

L. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).

M. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

N. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.

O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

P. ASTM B32 - Standard Specification for Solder Metal; 2020.

Q. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.

R. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

S. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

T. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.

U. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

V. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

W. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

X. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.

Y. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.

Z. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2017.

AA. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.

BB. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

CC. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).

DD. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2016.

EE. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

FF. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.

GG. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).

HH. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.

II. AWWA C606 - Grooved and Shouldered Joints; 2015.

JJ. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).

KK. CISPI 310 - 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; 2012 (Revised 2018).

LL. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

MM. MSS SP-67 - Butterfly Valves; 2017.

NN. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

OO. NSF 61 - Drinking Water System Components - Health Effects; 2020.

PP. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

C. Copper Tube: ASTM B306, DWV.
   1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.
   2. Joints: ASTM B32, alloy Sn50 solder.

D. PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
   1. Fittings: PVC.
   2. Joints: Push-on, using ASTM F477 elastomeric gaskets.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. Copper Pipe: ASTM B42.
   1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.
   2. Joints: ASTM B32, alloy Sn50 solder.

D. Aluminum DWV Pipe:
   1. Fittings: Cast iron.
   2. Joints: ASTM C564, thermoplastic rubber coupling and stainless steel clamps.

E. Steel Pipe: ASTM A53/A53M Schedule 40, galvanized, using one of the following joint types:
   1. Threaded Joints: ASME B16.4 cast iron fittings.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

F. PVC Pipe: ASTM D2729.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.04 CHEMICAL RESISTANT SEWER PIPING

A. PVC Pipe: ASTM D2729 or ASTM D2665.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.05 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

B. Ductile Iron Pipe: AWWA C151/A21.51.
   1. Fittings: Ductile or gray iron, standard thickness.
   2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch diameter rods.

2.06 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.

2.07 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. Copper Tube: ASTM B306, DWV.
   1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.

D. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.08 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 extra heavy weight.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. Copper Tube: ASTM B306, DWV.
   1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.
   2. Joints: ASTM B32, alloy Sn50 solder.

D. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.09 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type.
   2. Joints: ASME B31.1, welded.

3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.10 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

2.11 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 inch and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.
   2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Housing Material: Provide ASTM A47/A47M malleable iron or ductile iron, galvanized.
   3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.12 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
   2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes to 3 inch: Cast iron hook.
   4. Wall Support for Pipe Sizes 4 inch and Over: Welded steel bracket and wrought steel clamp.
   5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
   2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes Up to 3 inch: Cast iron hook.
   4. Wall Support for Pipe Sizes 4 inch and Larger: Welded steel bracket and wrought steel clamp.
   5. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
   6. Floor Support for Hot Pipe Sizes to 4 inch: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

2.13 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. The Metraflex Company; MetraSeal: www.metraflex.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.
   3. Elastomer element size and material in accordance with manufacturer's recommendations.
   4. Glass reinforced plastic pressure end plates.

2.14 BALL VALVES

A. Manufacturers:
   1. Apollo Valves: www.apollovalves.com/#sle.
   2. Grinnell Products: www.grinnell.com/#sle.
   3. Nibco, Inc: www.nibco.com/#sle.
   4. Uponor, Inc: www.uponorengineering.com/#sle.
   5. Viega LLC: www.viega.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Construction, 4 inch and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.15 BUTTERFLY VALVES

A. Manufacturers:
   1. Apollo Valves: www.apollovalves.com/#sle.
   2. Crane Company: www.cranecpe.com/#sle.
   3. Grinnell Products; B302: www.grinnell.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Construction 1-1/2 inch and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.16 PRESSURE REDUCING VALVES

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com/#sle.
   2. Apollo Valves: www.apollovalves.com/#sle.
   3. Cla-Val Company: www.cla-val.com/#sle.
   4. Flomatic Valves: www.flomatic.com/#sle.
   5. Watts Regulator Company: www.wattsregulator.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. 2 inch and Smaller:
   1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
   2. Pressure Reducing Pilot-Operator:
      a. Operating Range: 5 to 50 psi.
      b. Connected into brass or bronze pilot piping and fittings.
      c. Fixed flow restrictor, pressure gauges, and isolation valves.

C. 2 inch and Larger:
   1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.
   2. Pressure Reducing Pilot-Operator:
      a. Operating Range: 5 to 50 psi.
      b. Connected into brass or bronze pilot piping and fittings.
      c. Fixed flow restrictor, strainer, pressure gauges, and isolation valves.

2.17 RELIEF VALVES

A. Pressure Relief Valves:
   1. Manufacturers:
      a. Cla-Val Co: www.cla-val.com/#sle.
      b. Henry Technologies: www.henrytech.com/#sle.
      c. Watts Regulator Company: www.wattsregulator.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

B. Temperature and Pressure Relief Valves:
   1. Manufacturers:
      a. Cla-Val Co: www.cla-val.com/#sle.
      b. Henry Technologies: www.henrytech.com/#sle.
      c. Watts Regulator Company: www.wattsregulator.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.
   2. ANSI Z21.22, AGA certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME BPVC-IV certified and labelled.

2.18 STRAINERS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. Green Country Filter Manufacturing: www.greencountryfilter.com/#sle.
   3. WEAMCO: www.weamco.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Size 2 inch and Smaller:
   1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
   2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 1-1/2 inch to 4 inch:
   1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

D. Size 5 inch and Larger:
   1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed.

I. Install water piping to ASME B31.9.

J. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

K. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

L. Sleeve pipes passing through partitions, walls, and floors.

M. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

N. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.

O. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
   5. Tighten bolting for a watertight seal.
   6. Install in accordance with manufacturer's recommendations.

3.04 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed, and clean.

3.05 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.

3.06 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:

a. Pipe Size: 1/2 inch to 1-1/4 inch:
    1) Maximum Hanger Spacing: 6.5 ft.
    2) Hanger Rod Diameter: 3/8 inches.
b. Pipe Size: 1-1/2 inch to 2 inch:
    1) Maximum Hanger Spacing: 10 ft.
    2) Hanger Rod Diameter: 3/8 inch.
c. Pipe Size: 2-1/2 inch to 3 inch:
    1) Maximum Hanger Spacing: 10 ft.
    2) Hanger Rod Diameter: 1/2 inch.
d. Pipe Size: 4 inch to 6 inch:
    1) Maximum Hanger Spacing: 10 ft.
    2) Hanger Rod Diameter: 5/8 inch.
e. Pipe Size: 8 inch to 12 inch:
    1) Maximum hanger spacing: 14 ft.
    2) Hanger Rod Diameter: 7/8 inch.
f. Pipe Size: 14 inch and Over:
    1) Maximum Hanger Spacing: 20 ft.
    2) Hanger Rod Diameter: 1 inch.

2. Plastic Piping:
    a. All Sizes:
        1) Maximum Hanger Spacing: 6 ft.
        2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION

SECTION 221006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.
B. Cleanouts.
C. Hose bibbs.
D. Hydrants.
E. Washing machine boxes and valves.
F. Refrigerator valve and recessed box.
G. Back water valves.
H. Backflow preventers.
I. Double check valve assemblies.
J. Water hammer arrestors.
K. Sumps.
L. Sanitary waste interceptors.
M. Mixing valves.
N. Catch basins and manholes.

1.02 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains; 2019.
B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).
C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2017.
D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.
E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.
F. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).
G. DIN 19580 - Drainage channels for vehicular and pedestrian areas - Durability, mass per unit area and evaluation of conformity; 2010.
H. NSF 2 - Food Equipment; 2019.
I. NSF 61 - Drinking Water System Components - Health Effects; 2020.
J. NSF 372 - Drinking Water System Components - Lead Content; 2020.
K. PDI-WH 201 - Water Hammer Arresters; 2017.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
D. Operation Data: Indicate frequency of treatment required for interceptors.
E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Manufacturers:
   1. Acudor Platinum, a division of Acudor; New Construction Aluminum Drains: www.acudorplatinum.com/#sle.
   2. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
   3. Josam Company: www.josam.com/#sle.
   4. Sani-Floor Trough Systems; Clog-Free Floor Trough Systems: www.sanifloor.com/#sle.
   5. Zurn Industries, LLC: www.zurn.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Roof Drains:
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   3. Strainer: Removable polyethylene dome with vandal proof screws.
   4. Accessories: Coordinate with roofing type, refer to Section :
      a. Membrane flange and membrane clamp with integral gravel stop.
      b. Adjustable under deck clamp.
      c. Roof sump receiver.
      d. Waterproofing flange.
      e. Controlled flow weir.
      f. Leveling frame.
      g. Adjustable extension sleeve for roof insulation.
      h. Perforated or slotted ballast guard extension for inverted roof.
      i. Perforated stainless steel ballast guard extension.
   5. Manufacturers:
      a. OMG Roofing Products; Hercules-Plus: www.omgroofing.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.

C. Parapet Drains:
   1. Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated sloping grate.

D. Canopy and Cornice Drains:
   1. Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated flat strainer.

E. Roof Overflow Drains:
   1. Lacquered cast iron body and clamp collar and bottom clamp ring; pipe extended to 2 inches above flood elevation.

F. Downspout Nozzles:
   1. Bronze round with straight bottom section.

G. Area Drains:
   1. Assembly: ASME A112.6.4.
   2. Body: Lacquered cast iron with sump.
   3. Strainer: Round nickel-bronze.
   4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.

H. Linear Drains:

1. Body: Provide PVC, ABS, or stainless-steel with sloped channel to vertical waste pipe.
2. Clamping Ring: Stainless steel mechanism to clamp waterproof membrane to linear drain body.

I. Floor Drain (FD-1):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

J. Floor Drain (FD-2):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable round nickel bronze strainer with removable perforated sediment bucket.

K. Floor Drain (FD-3):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer with polished bronze funnel or anti-splash rim.

L. Floor Drain (FD-4):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze extra heavy duty strainer.

M. Floor Drain (FD-5):
1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze extra heavy duty strainer with hinged grate and sediment bucket.

N. Floor Drain (FD-6):
1. Lacquered cast iron or stainless steel, two piece body with drainage flange, heavy duty grate 6 inches wide, 12 inches long, dome strainer, end plates with gaskets.

O. Shower Channel Drain (SCD-1): Factory fabricated channel and grate with built in outlet pipe.
1. Basis of Design: ACO Polymer Products, Inc., QuARTz: www.quartzbyaco.com/#sle.
2. Channel Edge: Plain edge.
3. Plumbing Connector Type: Stainless steel.
4. Channel Length: 55 inches.
5. Grate Style: Solid tray to accept tile to match floor; with drainage slot at edges.
6. Substrate Construction: Wooden subfloor over joists.
7. Material: Electropolished stainless steel.
8. Outlet Pipe: 2 inch diameter.

P. Precast Trench Drain (TD-1): Trench drain system assembled from factory fabricated, polymer concrete castings in standard lengths and variable depths, with integral joint flanges and integral grating support rails; includes joint gaskets and grating.
1. Basis of Design: ACO Polymer Products, Inc., KlassikDrain: www.acousa.com/#sle.
2. Load Class: DIN 19580, Class A.
3. Trench Width: 12 inches.
4. Trench Section Length: 39 inches and 19-1/2 inches.
5. Grating Support Rail: Stainless steel.

Q. Floor Trough (FT-1):
1. Comply with NSF 2 construction.
2. Construction: 16 gauge, 0.0598 inch stainless steel.
3. Number of Grates: 1.
4. Grating: Fiberglass, green.

R. Planter Drains:

1. ASME A112.6.4; lacquered cast iron body with sump.
2. Strainer: Removable polyethylene dome with stainless steel screen.
3. Accessories: Membrane flange and membrane clamp with integral gravel stop.

2.03 CLEANOUTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
   2. Josam Company: www.josam.com/#sle.
   3. Zurn Industries, LLC: www.zurn.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Cleanouts at Exterior Surfaced Areas (CO-1):
   1. Round cast nickel bronze access frame and non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas (CO-2):
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

D. Cleanouts at Interior Finished Floor Areas (CO-3):
   1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

E. Cleanouts at Interior Finished Wall Areas (CO-4):
   1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

F. Cleanouts at Interior Unfinished Accessible Areas (CO-5): Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.04 HOSE BIBBS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
   2. Watts Regulator Company: www.wattsregulator.com/#sle.
   3. Zurn Industries, LLC: www.zurn.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Interior Hose Bibbs:
   1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

C. Interior Mixing Type Hose Bibbs:
   1. Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome plated where exposed with handwheels, and vacuum breaker in compliance with ASSE 1011.

2.05 HYDRANTS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
   2. Zurn Industries, LLC: www.zurn.com/#sle.

B. Wall Hydrants:
   1. ASSE 1019; freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.

C. Floor Hydrants:
   1. ASSE 1019; chrome plated lockable recessed box, hose thread spout, lockshield and removable key, and vacuum breaker.

2.06 WASHING MACHINE BOXES AND VALVES

A. Box Manufacturers:
   1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
   2. Oatey Supply Chain Services, Inc: www.oatey.com/#sle.
   3. Viega LLC: www.viega.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Valve Manufacturers:
   1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
   2. Viega LLC: www.viega.com/#sle.
   3. Zurn Industries, LLC: www.zurn.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

C. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch waste, slip in finishing cover.

2.07 REFRIGERATOR VALVE AND RECESSED BOX

A. Box Manufacturers:
   1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
   2. Oatey Supply Chain Services, Inc: www.oatey.com/#sle.
   3. Viega LLC: www.viega.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

2.08 BACK WATER VALVES

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
   2. Savko Plastic Pipe & Fittings, Inc: www.savko.com/#sle.
   3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Cast Iron Back Water Valves: ASME A112.6.4; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.

C. Plastic Back Water Valves: ABS body and valve, extension sleeve, and access cover.

2.09 BACKFLOW PREVENTERS

A. Manufacturers:
   1. Apollo Valves: www.apollovalves.com/#sle.
   2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
   3. Zurn Industries, LLC: www.zurn.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Reduced Pressure Backflow Preventer Assembly:
   1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
   2. Size: _____ inch assembly with threaded gate valves.

2.10 DOUBLE CHECK VALVE ASSEMBLIES

A. Double Check Valve Assembly:
   1. ASSE 1012; cast bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.
   2. Size: 3/4 to 2 inch, NPS assembly with threaded full port ball valves.

2.11 WATER HAMMER ARRESTORS

A. Manufacturers:
   1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.

2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Water Hammer Arrestors:
1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.12 SUMPS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Zurn Industries, LLC: www.zurn.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Precast concrete with required openings and drainage fittings.

C. Cover: 3/8 inch thick checkered steel plate with gasket seal frames and anchor bolts.

2.13 SANITARY WASTE INTERCEPTORS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Zurn Industries, LLC: www.zurn.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Oil Interceptors:
1. Construction:
a. Material: Epoxy coated fabricated steel.
b. Rough-in: On floor.
c. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port, recessed for floor finish.

C. Grease Interceptors:
1. Construction:
a. Material: Epoxy-coated fabricated steel.
b. Rough-in: On floor.
c. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port, recessed for floor finish.

D. Sand/Sediment Interceptors:
1. Epoxy coated cast iron body and secured cover with removable stainless steel sediment bucket.

2.14 MIXING VALVES

A. Thermostatic Mixing Valves:
1. Manufacturers:
a. ESBE: www.esbe.se/en.
b. Honeywell International Inc: www.honeywellhome.com/#sle.
c. Leonard Valve Company: www.leonardvalve.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
a. Check valve on inlets.
b. Volume control shut-off valve on outlet.
c. Stem thermometer on outlet.

d. Strainer stop checks on inlets.

4. Cabinet: 16 gauge, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.

B. Pressure Balanced Mixing Valves:

1. Manufacturers:
   a. Delta Faucet Company: www.deltafaucet.com/#sle.
   b. Tacotherm Ltd: www.tacotherm.co.uk.
   c. Substitutions: See Section 016000 - Product Requirements.
2. Valve: Chrome plated cast brass body, stainless steel cylinder, integral temperature adjustment.
3. Accessories:
   a. Volume control shut-off valve on outlet.
   b. Stem thermometer on outlet.
   c. Strainer stop checks on inlets.
   d. Cabinet: 16 gauge, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.

2.15 FLOOR DRAIN TRAP SEALS

A. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, washing machine outlets, or ice maker boxes..

H. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch minimum, and minimum 18 inches long.

END OF SECTION

SECTION 223000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water Heaters:
   1. Residential gas fired.
   2. Commercial gas fired.
   3. Residential oil fired.
   4. Commercial oil fired.
   5. Residential electric.
   6. Commercial electric.

B. Domestic water heat exchangers.

C. Domestic hot water storage tanks.

D. Diaphragm-type compression tanks.

E. Acid neutralizers.

F. In-line circulator pumps.

G. Pressure booster systems.

H. Sump pumps.

I. Sewage ejectors.

J. Submersible sump pumps.

K. Cooling condensate removal pumps.

L. Sanitary Sewage Pumps:
   1. Centrifugal solids handling.
   2. Screw.
   3. Recessed impeller.
   4. Progressive cavity.
   5. Plunger.
   6. Diaphragm.
   7. Rotary lobe.
   8. Submersible centrifugal.
   9. Self-priming centrifugal.

1.02 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 2014.

C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2019.

D. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

F. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data:
   1. Indicate pump type, capacity, power requirements.

2. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
3. Provide electrical characteristics and connection requirements.

C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

A. Manufacturers:
1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
2. Rheem Manufacturing Company: www.rheem.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Residential Gas Fired:
1. Type: Automatic, natural gas-fired, vertical storage.
2. Performance:
3. Tank: Glass lined welded steel with single flue passage, flue baffle and draft hood; thermally insulated and encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
4. Controls: Automatic water thermostat and built-in gas pressure regulator; temperature range adjustable from 120 to 170 degrees F, cast iron or sheet metal burner, safety pilot and thermocouple.
5. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.

C. Commercial Gas Fired:
1. Type: Automatic, natural gas-fired, vertical storage.
2. Performance:
3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
4. Accessories:
   a. Water Connections: Brass.
   b. Dip Tube: Brass.
   c. Drain valve.
   d. Anode: Magnesium.
   e. Temperature and Pressure Relief Valve: ASME labeled.
5. Certified For The Following Applications:
   a. Automatic storage water heater.
   b. Automatic circulating tank water heater.
   c. For operation at 180 degrees F.
   d. For operation on combustible floors.
   e. For operation in high altitude installations.

6. Controls: Automatic water thermostat with temperature range adjustable from 120 to 180 degrees F, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.

D. Residential Electric:
   1. Type: Automatic, electric, vertical storage.
   2. Performance:
   3. Electrical Characteristics:
   4. Tank: Glass lined welded steel, thermally insulated with one inch thick glass fiber; encased in corrosion-resistant steel jacket; baked-on enamel finish.
   5. Controls: Automatic water thermostat with externally adjustable temperature range from 120 to 170 degrees F, flanged or screw-in nichrome elements, enclosed controls and electrical junction box and operating light. Wire double element units so elements do not operate simultaneously.
   6. Accessories:
      a. Water Connections: Brass.
      b. Dip Tube: Brass.
      c. Drain valve.
      d. Anode: Magnesium.
      e. Temperature and Pressure Relief Valve: ASME labeled.

E. Commercial Electric:
   1. Type: Factory-assembled and wired, electric, vertical storage.
   2. Performance:
   3. Electrical Characteristics:
   4. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
   5. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
   6. Accessories:
   7. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gauges.
   8. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.02 DOMESTIC WATER HEAT EXCHANGERS

A. Manufacturers:
   1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
   2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Type: Double wall type that separates the potable water from the heat transfer medium with a space vented to the atmosphere in accordance with ICC IPC.

C. Tubes: U-tube type with 3/4 inch diameter seamless copper tubes suitable for 125 psi working pressure.

D. Heads: Cast iron or steel, with steel tube sheets, threaded or flanged for piping connections.

E. Water Chamber and Tube Bundle: Removable for inspection and cleaning.

F. Coating: Prime coat exterior.

G. Code: ASME BPVC-VIII-1 for service pressures, ASME "U" symbol stamped on heat exchanger.

H. Shell and Tube Type: Steel shell, with threaded or flanged piping connections and necessary tappings, steel saddle and attaching U-bolts, designed for heating fluid in shell and heated fluid in tubes.

I. Accessories:
   1. Wells for temperature regulator sensor and high limit sensor at water outlet.
   2. ASME rated pressure and temperature relief valve on water outlet.
   3. ASME rated pressure relief valves from tapping on heated water side, set at 120 psig.
   4. ASME rated pressure relief valve on steam inlet on downstream side of control valve.
   5. Thermometers and pressure gauge tappings in water inlet and outlet.
   6. Vacuum breaker and pressure gauge tapping with pigtail siphon in shell.

2.03 DOMESTIC HOT WATER STORAGE TANKS

A. Manufacturers:
   1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
   2. Wessels Company: www.westank.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Tank: Welded steel, ASME labeled for working pressure of 125 psig, steel support saddles, tappings for accessories, threaded connections of stainless steel, access manhole.

C. Openings: Up to 3 inches, copper-silicone threaded; over 4 inches, flanged; flanged collar for heat exchanger; manway fitting.

2.04 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com/#sle.
   2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
   3. Taco, Inc: www.taco-hvac.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.05 ACID NEUTRALIZERS

A. Manufacturers:
   1. Aquapure, 3M Purification, Inc: www.aquapure.com/#sle.
   2. Viqua, a division of Trojan Technologies ULC: www.viqua.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

2.06 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:
   1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
   2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
   3. Sterling SIHI GmbH: www.sterlingsihi.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Drive: Flexible coupling.

2.07 PRESSURE BOOSTER SYSTEMS

A. Manufacturers:
   1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
   2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
   3. Syncro Flo, Inc: www.syncroflo.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. System: Packaged with two pumps, factory assembled, tested, and adjusted; shipped to site as integral unit; consisting of pumps, valves, and galvanized piping, with control panel assembled on fabricated steel base with structural steel framework.

C. Controls and Instruments: Locate in NEMA 250 Type 1 general purpose enclosure with main disconnect interlocked with door, fused circuit for each motor, magnetic starters with three overloads, control circuit transformer with fuse protection, selector switch for each pump, low limit pressure switch, low pressure alarm light, running lights, current sensing devices, minimum run timers, manual alternation, and suction and discharge pressure gauges.

D. Lead Pump: Operate continuously with lag pump operating on system demand. Should lead pump fail to operate, next pump in sequence shall start automatically.

E. Time Delay Relay: Prevent lag pump short cycling on fluctuating demands.

F. Thermal Bleed Circuit with Solenoid Valve: Prevent overheating during low demand.

G. Low Pressure Control: Stop pump operation if incoming water pressure drops to atmospheric.

H. Pump Switch: Permit manual or automatic operation.

I. Valving: Each pump outlet combination pressure reducing and check valve to maintain constant system pressure. Provide gate or butterfly valves on suction and discharge of each pump. Provide check valve on each pump discharge.

J. Time Clock for Automatic Day-Night Changeover:
   1. Day cycle: System shall operate continuously with pressure to fixtures maintained by pressure reducing valves.
   2. Night Cycle: Pump shall operate intermittently on pressure switch located near pressure tank operating pump for pre-determined adjustable time period.

2.08 SUMP PUMPS

A. Manufacturers:
   1. Armstrong Fluid Technology: www.armstronfluidtechnology.com/#sle.
   2. Goulds Water Technology, a xylem brand: www.goulds.com/#sle.
   3. Zoeller Company: www.zoeller.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Type: Vertical centrifugal, direct connected, simplex arrangement.

C. Casing: Cast iron volute with radial clearance around impeller, inlet strainer, slide away couplings.

D. Impeller: Cast iron; open non-clog, keyed to corrosion resistant alloy steel shaft.

E. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.

F. Bearings: Forced grease lubricated bronze sleeve spaced maximum 48 inches and grease lubricated ball thrust at floor plate.

G. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.

H. Sump: Steel cover plate with steel curb frame for grouting into concrete sump with inspection opening and cover, and alarm fittings.

I. Controls (Duplex): Float operated mechanical alternator with float rod, stops, and corrosion resistant float to alternate operation of pumps, cut-in second pump on rising level or lead pump failure, separate pressure switch high level alarm with transformer, alarm bell, and standpipe and emergency float switch with float rod, stops, and corrosion resistant float to operate both pumps on failure of alternator.

2.09 SUBMERSIBLE SUMP PUMPS

A. Manufacturers:
   1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
   2. Goulds Water Technology, a xylem brand: www.goulds.com/#sle.
   3. Zoeller Company: www.zoeller.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Type: Completely submersible, vertical, centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber.

D. Impeller: Cast iron; open non-clog, stainless steel shaft.

E. Bearings: Ball bearings.

F. Sump: Fiberglass basin with steel cover plate; 48 inches diameter, 48 inches deep.

G. Accessories: Oil resistant 6 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

H. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.

I. Controls: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electro mechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn. Provide mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm.

2.10 COOLING CONDENSATE REMOVAL PUMPS

A. Manufacturers:
   1. Franklin Electric Company: www.franklin-electric.com/#sle.
   2. Liberty Pumps Inc: www.libertypumps.com/#sle.

B. Construction: Commercial grade, nonferrous pump with stainless steel shaft, integral discharge check valve, integral float switch, safety switch, thermoplastic reservoir, motor assembly, and power cord with ground.

C. Safety: UL 778.

D. Performance:
   1. Flow: Refer to schedule on drawings.
   2. Size: 48 inches diameter .
   3. Electrical Characteristics:
      a. Refer to schedule on drawings for motor HP size.
      b. Refer to schedule on drawings for electrical characteristics.

2.11 SANITARY SEWAGE PUMPS

A. Centrifugal Solids Handling:
   1. Manufacturers:
      a. Buffalo Pump, a subsidiary of Ampco-Pittsburgh Corporation: www.buffalopumps.com/#sle.
      b. Flowserve Corporation: www.flowserve.com/#sle.
      c. Hayward Gordon ULC: www.haywardgordon.com/#sle.

d. Substitutions: See Section 016000 - Product Requirements.

2. General: Non-clogging centrifugal type suitable for pumping solids up to 3 inches in diameter without internal interstices that can collect stringy materials and solids resulting in clogging.
3. Casing:
   a. Capable of withstanding operating pressures 50 percent greater than the maximum operating pressure.
   b. Plugged and tapped holes for draining and venting pump.
   c. Volute to consist of smooth passages.
   d. Configuration to permit removal of impeller without disturbing discharge and suction connections.
   e. Handhole to allow cleaning and inspection of pump interior.
   f. Lifting eyes to facilitate handling of pump.
4. Impeller:
   a. Design to consist of smooth passages to prevent clogging and pass fibrous or stringy material.
   b. Securely keyed to shaft with locking arrangement preventing loosening by torque from either forward or reverse direction.
   c. Balance statically, dynamically, and hydraulically within the operating range and to the first critical speed at 150 percent of the maximum operating speed.
5. Wearing Rings:
   a. Provide renewable wearing rings on the casing and impeller with wearing surfaces normal to the axis of rotation.
   b. Construction: Cast iron.
   c. Factory designed for simple maintenance and secured to prevent rotation.
   d. In lieu of wearing rings on impeller and casing, replaceable steel wear plates fastened to casing may be used.
6. Pump Shaft:
   a. Provide with adequate size and strength to transmit full driver horsepower with liberal safety factor.
   b. Fabricate from stainless steel.
7. Pump Shaft Sleeve:
   a. Fabricate from stainless steel.
   b. Seal joint between shaft and sleeve to prevent leakage.
   c. Stuffing Box:
      1) Factory designed for minimum 5 rings of packing with removable split type glands.
      2) Fabricate from same material as casing and water sealed.
8. Mechanical Seal System:
   a. Furnish single seals to seal pump shaft against leakage.
   b. Each seal to be held in place by its own spring system, supplemented by external liquid pressures.
   c. System to be readily removable from the shaft.
9. Bearings:
   a. Provide ball type designed to handle all thrust loads in either direction.
   b. Furnish with a L-10 life of minimum 50,000 hours as required by ABMA 9 or ABMA 11.
   c. Pumps depending only on hydraulic balance and thrust are not acceptable.
10. Lubrication:
    a. Bearing:
11. Pump Support:
    a. Vertical Shaft Centrifugal Pumps: Separate bases for pump and support.

12. Coupling:
    a. Provide heavy duty, flexible type, locked to the shaft.
    b. Disconnection of the coupling possible without removing the driver half or the pump half of the coupling from the shaft.

2.12 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.

B. Electrical characteristics to be as specified or indicated.

C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Domestic Water Heat Exchangers:
    1. Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
    2. Pipe relief valves and drains to nearest floor drain.

D. Domestic Water Storage Tanks:
    1. Provide steel pipe support, independent of building structural framing members.
    2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

E. Pumps:
    1. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.
B. Dual flush water closets.
C. Urinals.
D. Waterless urinals.
E. Lavatories.
F. All-in-one lavatory system.
G. Sinks.
H. Service sinks.
I. Under-lavatory pipe supply covers.
J. Electric water coolers.
K. Drinking fountains.
L. Bathtubs.
M. Showers.
N. Wash fountains.
O. Eye and face wash fountains.
P. Emergency showers.

1.02 REFERENCE STANDARDS

A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2014.
B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration.; 2013.
C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
D. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
E. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.
F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018.
G. ASME A112.19.14 - Six Liter Water Closets Equipped with Dual Flushing Device; 2013 (Reaffirmed 2018).
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.
I. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.
J. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
K. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
L. NSF 61 - Drinking Water System Components - Health Effects; 2020.
M. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Waterless Urinals: Submit recommended frequency of maintenance and parts replacement, methods of cleaning, sources of replacement supplies and parts.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 FLUSH VALVE WATER CLOSETS

A. Flush Valves:
   1. Manufacturers:
      a. American Standard, Inc: www.americanstandard-us.com/#sle.
      b. Sloan Valve Company: www.sloanvalve.com/#sle.
      c. Zurn Industries, Inc: www.zurn.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

B. Seats:
   1. Manufacturers:
      a. American Standard, Inc: www.americanstandard-us.com/#sle.
      b. Bemis Manufacturing Company: www.bemismfg.com/#sle.
      c. Church Seat Company: www.churchseats.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

C. Water Closet Carriers:
   1. Manufacturers:
      a. JOSAM Company: www.josam.com/#sle.
      b. Zurn Industries, Inc: www.zurn.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.

2.03 TANK TYPE WATER CLOSETS

A. Tank Type Water Closet Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. DXV by American Standard, Inc: www.dxv.com/#sle.
   3. Gerber Plumbing Fixtures LLC: www.gerberonline.com/#sle.
   4. Kohler Company: www.kohler.com/#sle.
   5. Zurn Industries, Inc: www.zurn.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Bowl: ASME A112.19.2; floor mounted, vitreous china reverse trap, close-coupled closet combination with regular rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps.

C. Seat Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Bemis Manufacturing Company: www.bemismfg.com/#sle.

3. Church Seat Company: www.churchseats.com/#sle.

2.04 DUAL FLUSH WATER CLOSETS

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Caroma USA, Inc: www.caromausa.com/#sle.
   3. Toto USA: www.totousa.com/#sle.
   4. Zurn Industries, Inc: www.zurn.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. ASME A112.19.14; high efficiency and low consumption, vitreous china, dual flush, tank type.
   1. Flush System: Pressure-assisted, wash down with a half-flush consumption of 1.1 GPF.
   2. Bowl: Elongated.
   3. Rough In: 12 inch.
   4. Seat: Manufacturer's standard or recommended elongated closed front seat with lid.
   5. Color: White.

2.05 WATERLESS URINALS

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Kohler Company: www.kohler.com/#sle.
   3. Sloan Valve: www.sloanvalve.com/#sle.
   4. Waterless Co: www.waterless.com/#sle.
   5. Zurn Industries, Inc: www.zurn.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Urinal: Wall-hung, vitreous china, complying with ASME A112.19.2; one piece bowl and shields, with integral trap, back outlet, carrier, and all necessary fittings.
   1. Trap Assembly: Siphon trap type not requiring additional water for drainage of urine; liquid trap seal that is lower specific gravity than water or urine and is biodegradable; completely enclosed cartridge intended to be replaced periodically or refillable liquid trap seal; tamperproof but removable for cleaning and replacement.
   2. Projection From Wall: Approximately 14 inches.
   3. Width: Approximately 19 inches.
   4. Color: White.

2.06 WALL HUNG URINALS

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Kohler Company: www.kohler.com/#sle.
   3. Zurn Industries, LLC; _____: www.zurn.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
   1. Flush Volume: 1.0 gallons, maximum.
   2. Flush Valve: Exposed (top spud).
   3. Flush Operation: Sensor operated.
   4. Trap: Integral.

C. Flush Valves:
   1. Manufacturers:
      a. American Standard, Inc: www.americanstandard-us.com/#sle.
      b. Sloan Valve Company: www.sloanvalve.com/#sle.
      c. Zurn Industries, Inc: www.zurn.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

D. Wall-Hung Urinal Carriers:
   1. Manufacturers:
      a. JOSAM Company: www.josam.com/#sle.
      b. Zurn Industries, Inc: www.zurn.com/#sle.
      c. Substitutions: See Section 016000 - Product Requirements.
   2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.07 LAVATORIES

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Kohler Company: www.kohler.com/#sle.
   3. Zurn Industries, Inc: www.zurn.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall hung lavatory, minimum, with 4 inch high back, rectangular basin with splash lip, front overflow, and soap depression.

C. Cast Iron Wall Hung Basin: ASME A112.19.1; porcelain enamelled cast iron wall-hung lavatory, minimum, with 4 inch high back, drillings on 4 inch centers, rectangular basin with splash lip, front overflow, and soap depression.

D. Vitreous China Counter Top Basin: ASME A112.19.2; vitreous china self-rimming counter top lavatory, with drillings on 4 inch centers, front overflow, soap depression, seal of putty, calking, or concealed vinyl gasket.

E. Vitreous China Under-Mount Basin: ASME A112.19.2; vitreous china under-mount lavatory, front overflow, mounting kit and template by manufacturer.

F. Pedestal Basin: ASME A112.19.2; vitreous china pedestal lavatory with integral rear splash rim, with drillings on 8 inch centers, front overflow, steel hanger.

G. Supply Faucet Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Kohler Company: www.kohler.com/#sle.
   3. Zurn Industries, Inc: www.zurn.com/#sle.

H. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 2.2 gallons per minute, indexed handles.

I. Metered Faucet: ASME A112.18.1; chrome plated metered mixing faucet with low voltage operated solenoid operator and infrared sensor, aerator and cover plate, open grid strainer.

J. Sensor Operated Faucet: Cast brass, chrome plated, wall mounted with sensor located on neck of spout.
   1. Spout Style: Standard.
   2. Power Supply: Battery, easily replaceable, alkaline or lithium, minimum 200,000 cycles.
      a. Low battery indicator warning light at 30 days remaining life and continuous light a 2 weeks.
   3. Mixing Valve: None, single line for tempered water.
   4. Water Supply: 3/8 inch compression connections.
   5. Aerator: Vandal resistant, 0.5 gpm, laminar flow device.
   6. Finish: Polished chrome.

2.08 WALL-HUNG MULTI-STATION LAVATORY UNITS - SOLID SURFACE

A. Description: Rectilinear, level-surface deck, seamless and integral elongated basin, with stainless steel enclosed pedestal cabinet.

B. Deck and Bowl Material: Fabricate from molded engineered stone material consisting of natural quartz, granite, and other minerals in a matrix of thermoset acrylic modified bio-based polyester resin and meeting requirements of IAPMO Z124.

C. Surface Burning Characteristics: Smoke developed index less than 450, and flame spread index less than 25, Class A, when tested in accordance with ASTM E84.

D. Number of Wash Stations: Two.

E. Unit Length:

F. Soap Dispenser:

G. Color: As selected by Architect from manufacturer's full line.

H. Faucet Drilling: 4 inch (100 mm) centerset drilling.

I. Access Panel: Stainless steel.

J. Support Frame: Wall mounted, heavy gauge, stainless steel.

2.09 ALL-IN-ONE LAVATORY SYSTEM

A. Manufacturers:
   1. Bradley Corporation; Advocate Lavatory System AV30: www.bradleycorp.com/#sle.

B. Wall-Mounted Integrated Lavatory Unit: Formed from molded solid surface material with integral bowl, wall mounting frame, built-in faucet, built-in soap dispenser, and hand dryer.

C. Bowl and Deck Material:
   1. Fabricate from bio-based resin and preconsumer recycled granules with minimum 25 percent preconsumer recycled content and 8 percent bio-based resins, solid surface material, certified by an approved independent testing agency and meeting requirements of IAPMO Z124.

D. Cabinet Construction: Type 300 stainless steel end panels with No. 3 finish, with high impact polymer front enclosure, mounted to wall with stainless steel mounting frame and basin support.

E. Fittings: Includes drain, P-trap, and flexible stainless steel supply connections.

F. Faucet:
   1. Built-in vandal-resistant, low profile faucet, formed from composite fiberglass-reinforced polymer with painted, clear-coat finish, with low-voltage sensor using a zone-focused, hand-detecting, infrared, transmitting beam and timed, turn-off delay.
   2. Flow Rate: Not greater than 0.38 gal/min.
   3. Solenoid Valve: 24 V, 50/60 Hz, electronically-activated, equipped with flow regulator and plug-in transformer.

2.10 SINKS

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Kohler Company: www.kohler.com/#sle.

2.11 UNDER-LAVATORY PIPE SUPPLY COVERS

A. Manufacturers:
   1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

2.12 BATHTUBS AND SHOWERS

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Kohler Company: www.kohler.com/#sle.

B. Bathtub: ASME A112.19.1 enamelled cast iron bathtub with slip resistant surface, contoured front apron, 60 inches long.

2.13 SHOWER RECEPTORS

A. Solid Surfacing Shower Receptors: Solid plastic resin casting, self-supporting, for installation over conventional subfloor; complying with IAPMO Z124.
   1. Material: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, renewable material filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
   2. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
   3. Finish on Exposed Surfaces: Provide satin or matte, gloss rating of 3 to 20.
   4. Manufacturers:
      a. American Standard, Inc: www.americanstandard-us.com/#sle.

B. Drain Trim: Removable chrome plated strainer and tail piece.

2.14 SHOWERS

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Aqua Glass Corporation: www.aquaglass.com/#sle.

2.15 DRINKING FOUNTAINS

A. Manufacturers:
   1. Elkay Manufacturing Company: www.elkay.com/#sle.
   2. Halsey Taylor: www.halseytaylor.com/#sle.
   3. Haws Corporation: www.hawsco.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Fountain: Molded white reinforced glass fiber with underside vandal proof cowling, hooded elevated anti-squirt bubbler with stream guard, automatic stream regulator, cross handle, mounting bracket, screwdriver stop.

2.16 ELECTRIC WATER COOLERS

A. Manufacturers:
   1. Elkay Manufacturing Company: www.elkay.com/#sle.
   2. Haws Corporation: www.hawsco.com/#sle.
   3. Oasis International: www.oasiscoolers.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Water Cooler: Electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
   1. Capacity: 8 gallons per hour of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
   2. Electrical: 115 V, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

2.17 SERVICE SINKS

A. Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Commercial Enameling Company: www.cecosinks.com/#sle.
   3. Elkay Manufacturing Company: www.elkay.com/#sle.
   4. Just Manufacturing Company: www.justmfg.com/#sle.

5. Zurn Industries, Inc: www.zurn.com/#sle.
6. Substitutions: See Section 016000 - Product Requirements.

B. Bowl: 36 by 24 by 10 inch high white molded stone, floor mounted, with one inch wide shoulders, vinyl bumper guard, stainless steel strainer.

C. Trim: ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.

D. Accessories:
1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
2. Hose clamp hanger.
3. Mop hanger.

2.18 EMERGENCY EYE AND FACE WASH

A. Manufacturers:
1. Haws Corporation: www.hawsco.com/#sle.
2. Therm-Omega-Tech, Inc: www.thermomegatech.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Emergency Wash: ANSI Z358.1; wall-mounted, self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray ring, stainless steel dust cover, copper alloy control valve and fittings.

2.19 EMERGENCY SHOWERS

A. Manufacturers:
1. Haws Corporation: www.hawsco.com/#sle.
2. Therm-Omega-Tech, Inc: www.thermomegatech.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Emergency Shower: ANSI Z358.1; wall-mounted, self- cleaning, non-clogging 8 inch diameter stainless steel deluge shower head with elbow, one inch full flow valve with pull chain and 8 inch diameter ring, one inch interconnecting fittings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports and bolts.

E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

A. Clean plumbing fixtures and equipment.

3.07 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Applications.

C. Single phase electric motors.

D. Three phase electric motors.

E. Electronically Commutated Motors (ECM).

1.02 RELATED REQUIREMENTS

A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. NEMA MG 1 - Motors and Generators; 2018.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.

C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.

E. Operation Data: Include instructions for safe operating procedures.

F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

B. Comply with NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.

B. Leeson Electric Corporation: www.leeson.com/#sle.

C. Regal-Beloit Corporation (Century): www.centuryelectricmotor.com/#sle.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service: Refer to Section 260583 for required electrical characteristics.

B. Electrical Service:
   1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
   2. Motors Larger than 1/2 Horsepower: three phase, 60 Hz. Voltage as shown on contract drawings.

C. Nominal Efficiency:
   1. Open Motor with Two Poles: 82.5.
   2. Open Motor with Four Poles: 82.5.
   3. Open Motor with Six Poles: 50.0.
   4. Enclosed Motor with Two Poles: 75.5.
   5. Enclosed Motor with Four Poles: 82.5.
   6. Enclosed Motor with Six Poles: 50.0.

D. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
   4. Motors with frame sizes 254T and larger: Energy efficient type.

E. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.

F. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

G. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.

B. Single phase motors for shaft mounted fans, oil burners, and centrifugal pumps: Split phase type.

C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.

D. Single phase motors for fans, pumps, blowers, and air compressors: Capacitor start type.

E. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.

F. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.

G. Motors located in outdoors, in wet air streams downstream of sprayed coil dehumidifiers, in draw through cooling towers, and in humidifiers: Totally enclosed weatherproof epoxy-treated type.

H. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

D. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

G. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

H. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

I. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

2.08 ELECTRONICALLY COMMUTATED MOTORS (ECM)

A. Manufacturers:
   1. US Motors, a brand of NIDEC Motor Corporation: www.usmotors.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Applications:
   1. Residential:
      a. Furnace:
         1) Operating Mode: Constant cfm.
         2) Input: Motor manufacturer to coordinate control requirements with the control board of the furnace.
         3) RPM: 300 through 1250.
   2. Commercial:
      a. Roof Top Unit:
         1) Operating Mode: Constant speed.
         2) Input: Motor manufacturer to coordinate control requirements with the control board of the roof top unit and/or specified sequence of operation.
         3) Shaft Extension: Single.
         4) RPM: 300 through 1200.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

D.

END OF SECTION

SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2018.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

G. MFMA-4 - Metal Framing Standards Publication; 2004.

H. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
   1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
   1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.

D. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with MSS SP-58.
   2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.
   5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
   6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
      b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
      c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Manufacturers:

a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
b. Thomas & Betts Corporation: www.tnb.com/#sle.
c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
d. Substitutions: See Section 016000 - Product Requirements.
e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MFMA-4.
4. Channel Material:
   a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
   b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.

C. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Manufacturers:
   a. Enduro Composites; _____: www.endurocomposites.com/#sle.
   b. Substitutions: See Section 016000 - Product Requirements.
   c. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Channel Material: Use polyester resin or vinyl ester resin.
3. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
4. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

D. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
   a. Equipment Supports: 1/2 inch diameter.
   b. Piping up to 1 inch (27 mm) nominal: 1/4 inch diameter.
   c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch diameter.
   d. Trapeze Support for Multiple Pipes: 3/8 inch diameter.

E. Steel Cable:
1. Manufacturers:
   a. Ductmate Industries, Inc, a DMI Company; Clutcher Cable Hanging System: www.ductmate.com/#sle.
   b. Substitutions: See Section 016000 - Product Requirements.
   c. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.

F. Thermal Insulated Pipe Supports:
1. Manufacturers:
   a. KB Enterprises: www.snappitz.com/#sle.
   b. Substitutions: See Section 016000 - Product Requirements.
2. General Construction and Requirements:
   a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
   b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.

c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch iron pipes.
d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.

3. PVC Jacket:
   a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
   b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
   c. Thickness: 60 mil.
4. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

G. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Manufacturers:
   a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
   b. Erico International Corporation, a brand of Pentair: www.erico.com/#sle.
   c. PHP Systems/Design: www.phpsd.com/#sle.
   d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
   e. Substitutions: See Section 016000 - Product Requirements.
2. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
5. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

H. Anchors and Fasteners:
1. Manufacturers - Mechanical Anchors:
   a. Hilti, Inc: www.us.hilti.com/#sle.
   b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
   c. Powers Fasteners, Inc: www.powers.com/#sle.
   d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
   e. Substitutions: See Section 016000 - Product Requirements.
2. Manufacturers - Powder-Actuated Fastening Systems:
   a. Hilti, Inc: www.us.hilti.com/#sle.
   b. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
   c. Powers Fasteners, Inc: www.powers.com/#sle.
   d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
   e. Substitutions: See Section 016000 - Product Requirements.
3. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
6. Hollow Masonry: Use toggle bolts.
7. Hollow Stud Walls: Use toggle bolts.
8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
9. Sheet Metal: Use sheet metal screws.
10. Wood: Use wood screws.
11. Plastic and lead anchors are not permitted.

12. Powder-actuated fasteners are permitted only as follows:
    a. Where approved by Architect.
13. Hammer-driven anchors and fasteners are permitted only as follows:
    a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction (when specified).
    b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction (when specified).
14. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.
    c. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
    d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
15. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

H. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
    5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners according to manufacturer's recommended torque settings.

K. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 230548
VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vibration isolation requirements.

B. Seismic control requirements.

C. Vibration-isolated equipment support bases.

D. Vibration isolators.

E. External seismic snubber assemblies.

F. Seismic restraint systems.

G. Vibration-isolated and/or seismically engineered roof curbs.

1.02 RELATED REQUIREMENTS

A. Section 014533 - Code-Required Special Inspections and Procedures.

B. Section 033000 - Cast-in-Place Concrete.

C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.

D. Section 210548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.

E. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

F. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.

1.03 DEFINITIONS

A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).

B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.04 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Seismic Controls:
      a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.

b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
2. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Vibration Isolation Systems:

1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

E. Shop Drawings - Seismic Controls:

1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify mounting conditions required for equipment seismic qualification.
3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.
7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

F. Seismic Design Data:

1. Compile information on project-specific characteristics of actual installed HVAC components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
   a. Component operating weight and center of gravity.
   b. Component elevation in the building in relation to the roof elevation (z/h).
   c. Component importance factor (Ip).
   d. For distributed systems, component materials and connection methods.
   e. Component amplification factor (ap) and component response modification factor (Rp), determined in accordance with ASCE 7 tables.
   f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

G. Certification for seismically qualified equipment; identify basis for certification.

H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

J. Evidence of qualifications for seismic controls designer.

K. Evidence of qualifications for manufacturer.

L. Manufacturer's detailed field testing and inspection procedures.

M. Field quality control test reports.

1.07 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
   1. Designer may be employed by the manufacturer of the seismic restraint products.

D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION REQUIREMENTS

A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.

B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:

C. General Requirements:
   1. Select vibration isolators to provide required static deflection.
   2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
   3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
   4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
   5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch operating clearance beneath base unless otherwise indicated.

D. Equipment Isolation: As indicated on drawings.

E. Piping Isolation:
   1. Provide vibration isolators for piping supports:
      a. Located in equipment rooms.
      b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
      c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.

2. Minimum Static Deflection:
    a. Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
7. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

F. Thrust Restraint Applications:
1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg or greater total static pressure.
2. Minimum Static Deflection: Same as static deflection of equipment.
3. Limit lateral movement to 0.25 inch or less unless otherwise indicated.

2.02 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
    a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
    b. Mason Industries: www.mason-ind.com/#sle.
    c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
    d. Substitutions: See Section 016000 - Product Requirements.

B. Vibration-Isolated Structural Steel Bases:
1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.

C. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
2. Minimum Base Depth: 6 inches.
3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.

2.03 VIBRATION ISOLATORS

A. Manufacturers:
1. Vibration Isolators:
    a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
    b. Mason Industries: www.mason-ind.com/#sle.
    c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
    d. Substitutions: See Section 016000 - Product Requirements.

B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
2. Spring Elements for Spring Isolators:
    a. Color code or otherwise identify springs to indicate load capacity.

b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
f. Selected to function without undue stress or overloading.

3. Seismic Snubbing Elements for Seismic Isolators:
   a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
   b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

C. Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
   a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
   b. Products:
      1) Substitutions: See Section 016000 - Product Requirements.
2. Restrained Spring Isolators, Seismic:
   a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
   b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
   c. Furnished with integral leveling device for positioning and securing supported equipment.
   d. Provides constant free and operating height.
   e. Products:
      1) Substitutions: See Section 016000 - Product Requirements.
3. Resilient Material Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b. Products:
4. Spring Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
   b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
   c. Products:
      1) Substitutions: See Section 016000 - Product Requirements.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
   a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the

lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.

b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

c. Products:

1) Substitutions: See Section 016000 - Product Requirements.

2.04 ACOUSTICAL AND VIBRATION ISOLATORS

A. Manufacturers:

1. Acoustical and Vibration Isolators:
   a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
   b. Substitutions: See Section 016000 - Product Requirements.
2. Source Limitations: Furnish isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.

B. General Requirements:

1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

A. Manufacturers:

1. External Seismic Snubber Assemblies:
   a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
   b. Mason Industries: www.mason-ind.com/#sle.
   c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
   d. Substitutions: See Section 016000 - Product Requirements.
2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.

B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

C. Seismic Snubbing Elements:

1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

D. Products:

1. Substitutions: See Section 016000 - Product Requirements.

2.06 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:

1. Seismic Restraint Systems:
   a. AFCON, a brand of Anvil International: www.anvilintl.com/#sle.
   b. Eaton Corporation: www.eaton.com/#sle.
   c. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
   d. Mason Industries: www.mason-ind.com/#sle.
   e. Substitutions: See Section 016000 - Product Requirements.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:
   1. Comply with ASCE 19.
   2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
   3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
   4. Use protective thimbles for cable loops where potential for cable damage exists.

D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

2.07 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

A. Manufacturers:
   1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
      a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
      b. Mason Industries: www.mason-ind.com/#sle.
      c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
      d. Substitutions: See Section 016000 - Product Requirements.

B. Vibration Isolation Curbs:
   1. Seismic Curb:
      a. Location: Between structure and rooftop equipment.
      b. Construction: Steel.
      c. Integral vibration isolation to comply with requirements of this section.
      d. Snubbers consist of minimum 0.25 inch thick resilient pads to avoid metal-to-metal contact without compromising vibration isolating capabilities.
      e. Weather exposed components consist of corrosion resistant materials.

C. Seismic Type Nonisolated Curb and Fabricated Equipment Piers:
   1. Location: Between structure and rooftop equipment.
   2. Construction: Steel.
   3. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 CODE-REQUIRED SPECIAL INSPECTIONS

A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.

B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
   1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
   2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

C. Seismic special inspections include, but are not limited to:

1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
3. Installation and anchorage of ductwork designed to carry hazardous materials for Seismic Design Categories C, D, E and F; periodic inspection.
4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch or less between equipment support frame and seismic restraint; periodic inspection.
5. Verification of required clearances between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.

D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Secure fasteners according to manufacturer's recommended torque settings.

D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.

E. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
   a. Provide specified minimum clearance beneath base.
2. Spring Isolators:
   a. Position equipment at operating height; provide temporary blocking as required.
   b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
   c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
3. Isolator Hangers:
   a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
   b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
6. Adjust isolators to be free of isolation short circuits during normal operation.
7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

F. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.

2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
    a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
    a. Size in accordance with seismic design to meet anchor requirements.
    b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
    a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    b. Install restraints within permissible angles in accordance with seismic design.
    c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
    e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect vibration isolation and/or seismic control components for damage and defects.

C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.

D. Vibration Isolation Systems:
    1. Verify isolator static deflections.
    2. Verify required clearance beneath vibration-isolated equipment support bases.
    3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.

E. Seismic Controls:
    1. Verify snubbing element air gaps.

F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic and steam systems.

C. Measurement of final operating condition of HVAC systems.

D. Sound measurement of equipment operating conditions.

E. Commissioning activities.

1.02 RELATED REQUIREMENTS

A. Section 019113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

B. Section 230800 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008 (Reaffirmed 2017).

C. NEBB (TAB) - Procedural Standard for Testing Adjusting and Balancing of Environmental Systems; 2019.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Submit to Architect.
   2. Submit to the Commissioning Authority.
   3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
   4. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
   5. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Identification and types of measurement instruments to be used and their most recent calibration date.
      d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      e. Final test report forms to be used.
      f. Detailed step-by-step procedures for TAB work for each system and issue, including:
         1) Terminal flow calibration (for each terminal type).

2) Diffuser proportioning.
3) Branch/submain proportioning.
4) Total flow calculations.
5) Rechecking.
6) Diversity issues.

g. Details of how TOTAL flow will be determined; for example:
1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.

h. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).

i. Method of checking building static and exhaust fan and/or relief damper capacity.

j. Proposed selection points for sound measurements and sound measurement methods.

k. Time schedule for deferred or seasonal TAB work, if specified.

l. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.

m. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Submit to the the Commissioning Authority within two weeks after completion of testing, adjusting, and balancing.
2. Revise TAB plan to reflect actual procedures and submit as part of final report.
3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
7. Units of Measure: Report data in I-P (inch-pound) units only.
8. Include the following on the title page of each report:
a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Project Architect.
g. Project Engineer.
h. Project Contractor.
i. Project altitude.
j. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:
   1. AABC (NSTSB), AABC National Standards for Total System Balance.
   2. SMACNA (TAB).
   3. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:
   1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
   2. Having minimum of three years documented experience.
   3. Certified by one of the following:
      a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
      b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
      c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

F. Pre-Qualified TAB Agencies:
   1. JEDI Balancing, Inc..
   2. Certified Balance, Inc..
   3. .

3.02 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
   1. Systems are started and operating in a safe and normal condition.
   2. Temperature control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
   10. Air outlets are installed and connected.
   11. Duct system leakage is minimized.
   12. Hydronic systems are flushed, filled, and vented.
   13. Pumps are rotating correctly.
   14. Proper strainer baskets are clean and in place.
   15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
   1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

I. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

J. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

K. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

L. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.07 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

3.08 COMMISSIONING

A. See Sections 019113 - General Commissioning Requirements and 230800 for additional requirements.

B. Perform prerequisites prior to starting commissioning activities.

C. Fill out Prefunctional Checklists for:
   1. Air side systems.
   2. Water side systems.

D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 100 percent of the air handlers plus a random sample equivalent to 100 percent of the final TAB report data as directed by Commissioning Authority.
   1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
   2. Use the same test instruments as used in the original TAB work.
   3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
   4. For purposes of re-check, failure is defined as follows:
      a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
      b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
      c. Temperatures: Deviation of more than one degree F.
      d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
      e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
   5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller

or the condenser water system.

F. In the presence of the Commissioning Authority, verify that:
   1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
   2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
   3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.09 SCOPE

A. Test, adjust, and balance the following:
   1. HVAC Pumps.
   2. Water Tube Boilers.
   3. Packaged Steel Water Tube Boilers.
   4. Packaged Steel Fire Tube Boilers.
   5. Forced Air Furnaces.
   6. Air Cooled Water Chillers.
   7. Centrifugal Water Chillers.
   8. Induced Draft Cooling Tower.
   9. Blow Through Cooling Tower.
   10. Air Cooled Refrigerant Condensers.
   11. Packaged Roof Top Heating/Cooling Units.
   12. Packaged Terminal Air Conditioning Units.
   13. Unit Air Conditioners.
   14. Computer Room Air Conditioning Units.
   15. Air Coils.
   16. Terminal Heat Transfer Units.
   17. Air Handling Units.
   18. Fans.
   19. Air Filters.
   20. Air Terminal Units.
   21. Air Inlets and Outlets.

3.10 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
   1. Manufacturer.
   2. Model/Frame.
   3. HP/BHP.
   4. Phase, voltage, amperage; nameplate, actual, no load.
   5. RPM.
   6. Service factor.
   7. Starter size, rating, heater elements.
   8. Sheave Make/Size/Bore.

B. V-Belt Drives:

1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.

C. Pumps:
1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

D. Air Cooled Condensers:
1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Serial number.

E. Chillers:
1. Identification/number.
2. Manufacturer.
3. Capacity.
4. Model number.
5. Serial number.
6. Evaporator entering water temperature, design and actual.
7. Evaporator leaving water temperature, design and actual.
8. Evaporator pressure drop, design and actual.
9. Evaporator water flow rate, design and actual.
10. Condenser entering water temperature, design and actual.
11. Condenser pressure drop, design and actual.
12. Condenser water flow rate, design and actual.

F. Cooling Tower:
1. Tower identification/number.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Rated capacity.
6. Entering air WB temperature, specified and actual.
7. Leaving air WB temperature, specified and actual.
8. Ambient air DB temperature.
9. Condenser water entering temperature.
10. Condenser water leaving temperature.
11. Condenser water flow rate.

12. Fan RPM.

G. Heat Exchangers:
   1. Identification/number.
   2. Location.
   3. Service.
   4. Manufacturer.
   5. Model number.
   6. Serial number.
   7. Primary water entering temperature, design and actual.
   8. Primary water leaving temperature, design and actual.
   9. Primary water flow, design and actual.
   10. Primary water pressure drop, design and actual.
   11. Secondary water leaving temperature, design and actual.
   12. Secondary water flow, design and actual.
   13. Secondary water pressure drop, design and actual.

H. Cooling Coils:
   1. Identification/number.
   2. Location.
   3. Service.
   4. Manufacturer.
   5. Air flow, design and actual.
   6. Entering air DB temperature, design and actual.
   7. Entering air WB temperature, design and actual.
   8. Leaving air DB temperature, design and actual.
   9. Leaving air WB temperature, design and actual.
   10. Water flow, design and actual.
   11. Water pressure drop, design and actual.
   12. Entering water temperature, design and actual.
   13. Leaving water temperature, design and actual.
   14. Saturated suction temperature, design and actual.
   15. Air pressure drop, design and actual.

I. Heating Coils:
   1. Identification/number.
   2. Location.
   3. Service.
   4. Manufacturer.
   5. Air flow, design and actual.
   6. Water flow, design and actual.
   7. Water pressure drop, design and actual.
   8. Entering water temperature, design and actual.
   9. Leaving water temperature, design and actual.
   10. Entering air temperature, design and actual.
   11. Leaving air temperature, design and actual.
   12. Air pressure drop, design and actual.

J. Electric Duct Heaters:
   1. Manufacturer.
   2. Identification/number.
   3. Location.
   4. Model number.

5. Design kW.
6. Number of stages.
7. Phase, voltage, amperage.
8. Test voltage (each phase).
9. Test amperage (each phase).
10. Air flow, specified and actual.
11. Temperature rise, specified and actual.

K. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

L. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

M. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.
10. Air correction factor.

N. Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.

4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.
11. Inlet static pressure.

O. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Design air flow.
6. Test (final) air flow.
7. Percent of design air flow.

P. Sound Level Reports:
1. Location.
2. Octave bands - equipment off.
3. Octave bands - equipment on.

END OF SECTION

SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct liner.

C. Insulation jackets.

1.02 RELATED REQUIREMENTS

A. Section 220553 - Identification for Plumbing Piping and Equipment.

B. Section 230553 - Identification for HVAC Piping and Equipment.

C. Section 233100 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

H. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.

L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
   1. Johns Manville: www.jm.com/#sle.
   2. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
   3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
   1. K value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 1200 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
   1. Kraft paper with glass fiber yarn and bonded to aluminized film.
   2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
   1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Outdoor Vapor Barrier Mastic:
   1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
   1. Johns Manville: www.jm.com/#sle.
   2. Knauf Insulation: www.knaufinsulation.com/#sle.
   3. Owens Corning Corporation; 700 Series FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C612; rigid, noncombustible blanket.
   1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
   2. Maximum Service Temperature: 450 degrees F.

3. Maximum Water Vapor Absorption: 5.0 percent.
4. Maximum Density: 8.0 lb/cu ft.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
1. Lagging Adhesive:
a. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.

C. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.016 inch sheet.
2. Finish: Embossed.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.05 DUCT LINER

A. Manufacturers:
1. Johns Manville: www.jm.com/#sle.
2. Knauf Insulation: www.knaufinsulation.com/#sle.
3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.

B.

C. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
3. Service Temperature: Up to 250 degrees F.
4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
5. Minimum Noise Reduction Coefficients:
a. 1/2 inch Thickness: 0.30.
b. 1 inch Thickness: 0.45.
c. 1-1/2 inches Thickness: 0.60.
d. 2 inch Thickness: 0.70.

D. Adhesive: Waterproof, fire-retardant type, ASTM C916.

E. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Insulated Ducts Conveying Air Below Ambient Temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Insulated Ducts Conveying Air Above Ambient Temperature:
   1. Provide with or without standard vapor barrier jacket.
   2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

D. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with canvas jacket sized for finish painting.

E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.

F. External Duct Insulation Application:
   1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
   2. Secure insulation without vapor barrier with staples, tape, or wires.
   3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
   4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
   5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct and Plenum Liner Application:
   1. Adhere insulation with adhesive for 90 percent coverage.
   2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
   3. Seal and smooth joints. Seal and coat transverse joints.
   4. Seal liner surface penetrations with adhesive.
   5. Duct dimensions indicated are net inside dimensions required for air-flow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

A. Combustion Air Duct:
   1. Flexible Glass Fiber Duct Insulation: 1/2" thick flexible glass fiber duct wrap.

B. Exhaust Ducts Within 10 ft of Exterior Openings: 1/2" thick flexible glass fiber duct wrap.

C. Outside Air Intake Ducts: 1" thick flexible cellular glass fiber duct wrap.

D. Plenums: Lined with fiberglass duct liner with reinforced coating system. Liner to have minimum manufacturer's "as installed" R value of R-6 or greater.

E. Supply and Return Ducts (where located in unconditioned spaces; includes crawlspaces both ventilated and unventilated): Wrapped with flexible glass fiber duct wrap or lined with flexible glass duct liner with reinforced coating system as noted on the contract drawings. Insulation to have "as installed" manufacturer's minimum R value of R-6 or greater.

F. Supply and Return Ducts (where located in indirectly conditioned spaces and includes return air plenums with or without exposed roofs above): Lined with 1" flexible glass duct liner with reinforced coating system as noted on the contract drawings.

G. Supply ducts After Terminal Boxes: Where located in unconditioned spaces; includes crawlspaces both ventilated and unventilated: Wrapped with flexible glass fiber duct wrap or lined with flexible glass duct liner with reinforced coating system as noted on the contract drawings. Insulation to have "as installed" manufacturer's minimum R value of R-6 or greater. Where located in indirectly conditioned spaces and includes return air plenums with or without exposed roofs above: Lined with 1" flexible glass duct liner with reinforced coating system as noted on the contract drawings.

H. Ducts Exposed to Outdoors: Wrapped with flexible glass fiber duct wrap or lined with flexible glass duct liner with reinforced coating system as noted on the contract drawings. Insulation to have "as installed" manufacturer's minimum R value of R-12 or greater. Duct to have aluminum jacket sealed weathertight.

END OF SECTION

SECTION 230716
HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment insulation.

B. Covering.

C. Breeching insulation.

1.02 RELATED REQUIREMENTS

A. Section 230553 - Identification for HVAC Piping and Equipment.

B. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

C. Section 232300 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017.

H. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2021.

I. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

J. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

K. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

M. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation; Atmosphere Duct Wrap: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C553; flexible, noncombustible.
   1. K Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
   2. Maximum Service Temperature: 450 degrees F.
   3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
   1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
   2. Secure with self-sealing longitudinal laps and butt strips.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.03 GLASS FIBER, RIGID

A. Manufacturer:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation; Earthwool Insulation Board: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
   5. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.

1. K Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 850 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.
4. Maximum Density: 8.0 lb/cu ft.

C. Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with self-sealing longitudinal laps and butt strips.

D. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.04 CELLULAR GLASS

A. Manufacturer:
1. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
1. K Value: 0.35 at 100 degrees F.
2. Service Temperature Range: From 250 degrees F to 800 degrees F.
3. Water Vapor Permeability: 0.005 perm inch maximum per inch.
4. Water Absorption: 0.5 percent by volume, maximum.
5. Density: At least 6.12 lb/cu ft.

C. Block Insulation: ASTM C552, Type I, Grade 6.

2.05 HYDROUS CALCIUM SILICATE

A. Manufacturer:
1. Johns Manville Corporation: www.jm.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C533; rigid molded, asbestos free, gold color.
1. K Value: 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
2. Maximum Service Temperature: 1200 degrees F.
3. Density: 15 lb/cu ft.

C. Tie Wire: 0.048 inches stainless steel with twisted ends on maximum 12 inch centers.

D. Insulating Cement: ASTM C449.

2.06 JACKETS

A. PVC Plastic:
1. Manufacturers:
a. Johns Manville Corporation: www.jm.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.
2. Jacket: Sheet material, off-white color.
a. Minimum Service Temperature: Minus 40 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.

3. Covering Adhesive Mastic: Compatible with insulation.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
   1. Lagging Adhesive: Compatible with insulation.

C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
   1. Thickness: 0.016 inch sheet.
   2. Finish: {CH#127298}.
   3. Joining: Longitudinal slip joints and 2 inch laps.
   4. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

G. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

H. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.

I. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

J. Inserts and Shields:
   1. Application: Equipment 1-1/2 inches diameter or larger.
   2. Shields: Galvanized steel between hangers and inserts.
   3. Insert Location: Between support shield and equipment and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

K. Finish insulation at supports, protrusions, and interruptions.

L. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.

M. Exterior Applications:
   1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
   2. Cover with {CH#127328}.

N. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

O. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

P. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

A. Heating Systems:
   1. Pump Bodies:
   2. Heat Exchangers/Converters:
   3. Air Separators:
   4. Hot Thermal Storage Tanks:
   5. Condensate Tanks:
   6. Flue Gas Breeching:

B. Cooling Systems:
   1. Pump Bodies:
   2. Air Separators:
   3. Cold Thermal Storage Tanks:

END OF SECTION

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

C. Casings and plenums.

D. Buried ductwork.

E. Kitchen hood ductwork.

F. Duct cleaning.

1.02 RELATED REQUIREMENTS

A. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

B. Section 230713 - Duct Insulation: External insulation and duct liner.

C. Section 233300 - Air Duct Accessories.

D. Section 233600 - Air Terminal Units.

E. Section 233700 - Air Outlets and Inlets.

1.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

E. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials, duct liner, and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for half inch pressure class and higher systems.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).

E. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.

F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience.

1.06 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

A. Regulatory Requirements: Construct ductwork to comply with NFPA 90A standards.

B. Ducts: Galvanized steel, unless otherwise indicated.

C. Low Pressure Supply (Heating Systems): 1/2 inch w.g. pressure class, galvanized steel.

D. Low Pressure Supply (System with Cooling Coils): 1/2 inch wg pressure class, galvanized steel.

E. Buried Supply or Return: 1/2 inch w.g. pressure classfiber glass reinforced plastic HDPE.

F. Medium and High Pressure Supply: 1/2 inch wg pressure class, galvanized steel.

G. Return and Relief: 1/2 inch wg pressure class, galvanized steel.

H. General Exhaust: 1/2 inch wg pressure class, galvanized steel.

I. Kitchen Cooking Hood Exhaust: 1/2 inch w.g. pressure class, un-galvanized steel.
   1. Construct of 16 gauge, 0.0598 inch sheet steel using continuous external welded joints in rectangular sections.

J. Dishwasher Exhaust: 1/2 inch w.g. pressure class, stainless steel.
   1. Construct of 18 gauge, 0.0500 inch stainless steel using continuous external welded joints in rectangular sections.

K. Grease Exhaust: 1/2 inch w.g. pressure class, un-galvanized steel.
   1. Construct of 16 gauge un-galvanized steel.
   2. Construction:
      a. Liquidtight with continuous external weld for all seams and joints.
      b. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
   3. Access Doors:
      a. Provide for duct cleaning inside horizontal duct at drain pockets, every 10 feet and at each change of direction.
      b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.

L. Fume Hood Exhaust: 1/2 inch wg pressure class, galvanized steel.

M. Outside Air Intake: 1/2 inch wg pressure class, galvanized steel.

N. Combustion Air: 1/2 inch wg pressure class, galvanized steel.

O. Transfer Air and Sound Boots: 1/2 inch wg pressure class, fibrous glass.

2.02 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

C. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

2.03 MANUFACTURED DUCTWORK AND FITTINGS

A. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of galvanized 18 gauge, 0.0478 inch expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.

END OF SECTION

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.
B. Backdraft dampers - metal.
C. Backdraft dampers - fabric.
D. Combination fire and smoke dampers.
E. Duct access doors.
F. Fire dampers.
G. Flexible duct connectors.
H. Smoke dampers.
I. Volume control dampers.

1.02 RELATED REQUIREMENTS

A. Section 233100 - HVAC Ducts and Casings.
B. Section 233600 - Air Terminal Units: Pressure regulating damper assemblies.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.
B. NFPA 92 - Standard for Smoke Control Systems; 2018.
C. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).
E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
G. UL 555C - Standard for Safety Ceiling Dampers; 2014 (Revised 2017).
H. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, fire dampers, and smoke dampers.
D. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.
E. Project Record Drawings: Record actual locations of access doors.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.03 BACKDRAFT DAMPERS - FABRIC

2.04 COMBINATION FIRE AND SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

B. Provide factory sleeve and collar for each damper.

C. Multiple Blade Dampers: Fabricate with 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.

D. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on exterior of duct and link to damper operating shaft.

E. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.

F. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.05 DUCT ACCESS DOORS

A. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
   1. Less Than 12 inches Square: Secure with sash locks.
   2. Up to 18 inches Square: Provide two hinges and two sash locks.
   3. Up to 24 by 48 inches: Three hinges and two compression latches with outside and inside handles.
   4. Larger Sizes: Provide an additional hinge.
   5. High Temperature Duct Access Doors:
      a. Comply with NFPA 96.

B. Access doors with sheet metal screw fasteners are not acceptable.

2.06 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

B. Ceiling (Radiation) Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame and 16 gauge, 0.0598 inch flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
   1. Rated for three hour service in compliance with UL 555C.

C. Horizontal Dampers: Galvanized steel, 22 gauge, 0.0299 inch frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

D. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

E. Multiple Blade Dampers: 16 gauge, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

F. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.07 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
      a. Net Fabric Width: Approximately 2 inches wide.
   2. Metal: 3 inches wide, 24 gauge, 0.0239 inch thick galvanized steel.

C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

D. Maximum Installed Length: 14 inch.

2.08 SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.

B. Dampers: UL Class 1 airfoil blade type smoke damper, normally open automatically operated by electric actuator.

C. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.09 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Splitter Dampers:
   1. Material: Same gauge as duct to 24 inches size in either direction, and two gauges heavier for sizes over 24 inches.
   2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
   3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw.

C. Single Blade Dampers:
   1. Fabricate for duct sizes up to 6 by 30 inch.
   2. Blade: 24 gauge, 0.0239 inch, minimum.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gauge, 0.0478 inch, minimum.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96 Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.

F. Demonstrate re-setting of fire dampers to Owner's representative.

G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

H. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

I. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.

J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

K. Use splitter dampers only where indicated.

L. Provide balancing dampers on high velocity systems where indicated. Refer to Section 233600 - Air Terminal Units.

M. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 233413
AXIAL HVAC FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tubeaxial fans.

B. Propeller fans.

C. Motors and drives.

D. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 230513 - Common Motor Requirements for HVAC Equipment.

B. Section 230913 - Instrumentation and Control Devices for HVAC.

C. Section 233300 - Air Duct Accessories: Backdraft dampers.

1.03 REFERENCE STANDARDS

A. 29 CFR 1910 - Occupational Safety and Health Standards; current edition.

B. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

D. AMCA 99 - Standards Handbook; 2016.

E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.

F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on axial fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate assembly of axial fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

D. Test Reports: Indicate performance data for adjustable axial fan blades for at least five blade settings, including maximum.

E. Manufacturer's Instructions: Indicate installation instructions.

F. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.07 FIELD CONDITIONS

A. Permanent fans may not be used for ventilation during construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 AXIAL FANS

A. Manufacturers:
   1. ACME Engineering and Manufacturing Corporation: www.acmefan.com/#sle.
   2. Greenheck Fan Corporation; greenheck.com
   3. Loren Cook Company: www.lorencook.com/#sle.
   4. PennBarry, Division of Air Systems Components: www.pennbarry.com/#sle.
   5. Twin City Fan & Blower; TCVX: www.tcf.com/#sle.
   6. Substitutions: See Section 016000 - Product Requirements.

B. Performance Requirements:
   1. Performance Ratings: AMCA 210, bearing certified rating seal.
   2. Sound Ratings: AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
   3. Fabrication: Comply with AMCA 99.
   4. Performance Base: 5000 foot elevation conditions.
   5. Temperature Limit: Maximum 300 degrees F.

C. Hub and Impeller:
   1. Airfoil Impeller Blades: Adjustable die cast aluminum alloy glass reinforced polyester resin or welded steel die formed blades with belt drive.
   2. Hub: Die cast aluminum alloy or cast iron hub or with belt drive of spun, welded steel, bored and keyed to shaft; to facilitate indexing of blade angle with manual adjustment stops.
   3. Controllable Pitch Assemblies: Incorporate ball bearing counterbalanced blade and variable pitch assembly into hub with mechanical link to casing exterior mounted actuator, or pneumatic or electric actuator incorporated within hub.
   4. Cast Components: X-ray components after fabrication and statically and dynamically balance assembly before attachment to motor or shaft.

D. Casing:
   1. Fabricate casing of 1/4 inch steel for fans 40 inch in diameter and smaller and 3/8 inch steel for larger fans.
   2. Continuously weld, with inlet and outlet flange connections, and motor or shaft supports. Incorporate flow straightening guide vanes for fans specified for static pressures greater than 1 in-wc.
   3. Finish with one coat enamel applied to interior and exterior.

E. Bearings and Drives:
   1. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA STD 9 L-10 life at 50,000 hours.
   2. Shafts: Hot rolled steel, ground and polished, with keyway; protectively coated with lubricating oil.
   3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
   4. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan

supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

5. Lubrication: Extend lubrication fittings to outside of casing.

F. Accessories:
   1. Guide Vanes: Welded steel construction with airfoil vanes and casing flanges, finished to match casing.
   2. Adjustable Inlet Vanes: Steel construction with blades supported at both ends with two permanently lubricated bearings, variable mechanism out of air stream terminating in single control lever with control shaft for double width fans and locking quadrant.
   3. Inlet Bell: Bell mouth inlet fabricated of steel with flange.
   4. Outlet Cones: Fabricated of steel with flanges, outlet area/inlet area ratio of 1.5/1.0, with center pod as recommended by manufacturer.
   5. Inlet Screens: Galvanized steel welded grid to fit inlet bell.
   6. Dampers: Welded steel construction, consisting of two semi-circular vanes pivoted on oil-retaining bearings in short casing section, finished with one coat enamel. Provide airstream operation closing blades by reverse air flow and gravity.
   7. Access Doors: Shaped to fit casing with quick opening latches and gaskets.
   8. Blade Pitch Actuator: Factory mounted and calibrated, electric actuator requiring single phase power and accepting electric input.
   9. Stall Alarm Probe: Factory installed sensing probe to detect fan operation in stall. See Section 230913.

2.03 PROPELLER FANS

A. Manufacturers:
   1. ACME Engineering and Manufacturing Corporation: www.acmefan.com/#sle.
   2. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
   3. Greenheck Fan Corporation; greenheck.com
   4. Loren Cook Company: www.lorencook.com/#sle.
   5. PennBarry, Division of Air Systems Components: www.pennbarry.com/#sle.
   6. Twin City Fan & Blower: www.tcf.com/#sle.
   7. Substitutions: See Section 016000 - Product Requirements.

B. Impeller: Shaped steel or steel reinforced aluminum blade with heavy hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or provided with V-belt drive.

C. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

D. Accessories:
   1. Backdraft Damper: Multiple blade with offset hinge pin, blades linked.
   2. Safety Screens: Expanded galvanized metal over inlet, motor, drive; to comply with 29 CFR 1910.
   3. Hood: Weathershield, to exclude rain and snow.
   4. Controller: Solid-state speed controller.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install flexible connections specified in Section 233300 between axial fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and axial fan while running.

C. Provide fixed sheaves required for final air balance.

D. Provide safety screen where inlet or outlet is exposed.

E. Provide backdraft dampers on discharge of exhaust fans and as indicated.

F. Provide access to adjustable blade axial fan wheels for varying blade angle setting. Adjust blades for varying range of volume and pressure.

G. Provide floor mounted axial fans with reinforced legs. Provide ceiling suspended units with support brackets bolted to casing flange.

END OF SECTION

SECTION 233416
CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Backward inclined centrifugal fans.

B. Forward curved centrifugal fans.

C. Airfoil wheel centrifugal fans.

D. Bearings and drives.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 230513 - Common Motor Requirements for HVAC Equipment.

B. Section 230548 - Vibration and Seismic Controls for HVAC.

C. Section 230713 - Duct Insulation.

D. Section 233300 - Air Duct Accessories: Backdraft dampers.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

C. AMCA 99 - Standards Handbook; 2016.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

D. Manufacturer's Instructions: Include complete installation instructions.

E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Extra Fan Belts: One set for each individual fan.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.07 FIELD CONDITIONS

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ACME Engineering and Manufacturing Corporation; _____: www.acmefan.com/#sle.

B. Greenheck Fan Corporation; greenheck.com

C. Loren Cook Company; _____: www.lorencook.com/#sle.

D. PennBarry, Division of Air System Components; _____: www.pennbarry.com/#sle.

E. Twin City Fan & Blower; _____: www.tcf.com/#sle.

F. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Comply with AMCA 99.

D. Performance Base: 5000 foot elevation conditions.

E. Temperature Limit: Maximum 300 degrees F.

F. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

2.03 WHEEL AND INLET

A. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

B. Forward Curved: Galvanized steel construction with inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and back plate; steel hub swaged to back plate and keyed to shaft with set screw.

C. Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy back plate die formed hollow airfoil shaped blades continuously welded at tip flange, and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.

2.04 HOUSING

A. Heavy gauge steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.

B. Factory finish before assembly to manufacturer's standard. For fans handling air downstream of humidifiers, provide two additional coats of paint. Prime coating on aluminum parts is not required.

C. Provide bolted construction with horizontal flanged split housing, where indicated.

D. Fabricate plug fans without volute housing, in lined steel cabinet. Refer to Section 230713.

2.05 BEARINGS AND DRIVES

A. Bearings: Heavy duty pillow block type, selfgreasing ball bearings, with ABMA STD 9 life at 100,000 hours.

B. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard.

C. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under, selected so required rpm is obtained with sheaves set at mid Fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

D. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

2.06 ACCESSORIES

A. Fixed Inlet Vanes: Steel construction with fixed cantilevered inlet guide vanes welded to inlet bell.

B. Adjustable Inlet Vanes: Steel construction with blades supported at both ends with two permanently lubricated bearings, variable mechanism out of air stream terminating in single control lever with control shaft for double width fans and locking quadrant.

C. Discharge Dampers: Parallel blade heavy duty steel damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever.

D. Inlet/Outlet Screens: Galvanized steel welded grid.

E. Access Doors: Shaped to fit scroll, with quick opening latches and gaskets.

F. Scroll Drain: 1/2 inch steel pipe coupling welded to low point of fan scroll.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install fans with resilient mountings and flexible electrical leads. Refer to Section 230548.

C. Install flexible connections between fan inlet and discharge ductwork; refer to Section 233300. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Install fan restraining snubbers; refer to Section 230548. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

E. Provide fixed sheaves required for final air balance.

F. Provide safety screen where inlet or outlet is exposed.

G. Pipe scroll drains to nearest floor drain.

H. Provide backdraft dampers on discharge of exhaust fans and as indicated; refer to Section 233300.

END OF SECTION

SECTION 233423
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof exhausters.
B. Roof ventilators.
C. Wall exhausters.
D. Cabinet exhaust fans.
E. Ceiling exhaust fans.
F. Fire-rated enclosures.
G. Upblast roof exhausters.
H. Inline centrifugal fans and blowers.
I. Kitchen hood upblast roof exhausters.
J. Utility vent blower sets.
K. Laboratory and fume exhaust.

1.02 RELATED REQUIREMENTS

A. Section 230513 - Common Motor Requirements for HVAC Equipment.
B. Section 230548 - Vibration and Seismic Controls for HVAC.
C. Section 233300 - Air Duct Accessories: Backdraft dampers.

1.03 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
B. AMCA 99 - Standards Handbook; 2016.
C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2005 (Reaffirmed 2012).
D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.
G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2021.
I. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and

electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.07 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Greenheck Fan Corporation; _____: www.greenheck.com/#sle.

B. Loren Cook Company; _____: www.lorencook.com/#sle.

C. PennBarry, Division of Air System Components; _____: www.pennbarry.com/#sle.

D. Twin City Fan & Blower; _____: www.tcf.com/#sle.

E. Substitutions: See Section 016000 - Product Requirements.

2.02 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: Comply with AMCA 204.

B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

D. Fabrication: Comply with AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 ROOF VENTILATORS

A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

B. Roof Curb: 8 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.

C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and wall mounted multiple speed switch or solid state speed controller.

D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.04 WALL EXHAUSTERS

A. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch mesh, 0.062 inch thick aluminum wire bird screen.

B. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor, and wall mounted multiple speed switch.

C. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

D. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.05 CABINET EXHAUST FANS

A. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor and wall mounted solid state speed controller.

C. Grille: Molded white plastic.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.06 FIRE-RATED ENCLOSURES

A. Manufacturers:
   1. Fire Rated Product Specialties Corp: www.frpsonline.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Provide as required to preserve fire resistance rating of building elements.

2.07 UPBLAST ROOF EXHAUSTERS

A. Belt Drive Fan:
   1. Fan Wheel:
      a. Type: Non-overloading, backward inclined centrifugal.
      b. Material: Aluminum, statically and dynamically balanced.
   2. Housing:
      a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
      b. Rigid internal support structure.
      c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
      d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
      e. Provide breather tube for fresh air motor cooling and wiring.

B. Shafts and Bearings:
   1. Fan Shaft:
      a. Ground and polished steel with anti-corrosive coating.
      b. First critical speed at least 25 percent over maximum cataloged operating speed.
   2. Bearings:
      a. Permanently sealed or pillow block type.
      b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
      c. 100 percent factory tested.

C. Drive Assembly:
   1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
   2. Belts: Static free and oil resistant.
   3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
   4. Motor pulley adjustable for final system balancing.
   5. Readily accessible for maintenance.

D. Disconnect Switches:
   1. Factory mounted and wired.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Indoor Clean, Dry Locations: Type 1.
      b. Outdoor Locations: Type 3R.
   3. Finish for Painted Steel Enclosures: Provide manufacturer's standard or factory applied gray unless otherwise indicated.
   4. Positive electrical shutoff.
   5. Wired from fan motor to junction box installed within motor compartment.

E. Roof Curb: 8 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips, insulation and curb bottom, curb bottom, ventilated double wall, and factory installed nailer strip.

F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

G. Options/Accessories:
   1. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.
   2. Birdscreen:
      a. Provide galvanized steel construction.
      b. Protects fan discharge.
   3. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
   4. Dampers: Provide motorized type.
   5. Drain Connection:
      a. Aluminum construction.
      b. Allows single-point drainage of grease, water, or other residues.
   6. Finishes: Factory primed.
   7. Hinge Kit:
      a. Aluminum hinges.
      b. Hinges and restraint cables mounted to base (sleeve).
      c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
   8. Heat Baffle: Prevents heat from radiating into motor compartment.
   9. Tie-down Points: Four brackets located on windband secures fan in heavy wind applications.

2.08 INLINE CENTRIFUGAL FANS AND BLOWERS

A. Disconnect Switch: Cord and plug in housing for thermal overload protected motor and wall mounted switch.

B. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.09 KITCHEN HOOD UPBLAST ROOF EXHAUSTERS

A. Belt Drive Fan:
   1. Fan Wheel:
      a. Type: Non-overloading, backward inclined centrifugal.
      b. Material: Aluminum, statically and dynamically balanced.
   2. Housing:
      a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
      b. Rigid internal support structure.

c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
e. Provide breather tube for fresh air motor cooling and wiring.

B. Shafts and Bearings:
1. Fan Shaft:
a. Ground and polished steel with anti-corrosive coating.
b. First critical speed at least 25 percent over maximum cataloged operating speed.
2. Bearings:
a. Permanently sealed or pillow block type.
b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
c. 100 percent factory tested.

C. Drive Assembly:
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
2. Belts: Static free and oil resistant.
3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
4. Motor pulley adjustable for final system balancing.
5. Readily accessible for maintenance.

D. Disconnect Switches:
1. Factory mounted and wired.
2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
a. Indoor Clean, Dry Locations: Type 1.
b. Outdoor Locations: Type 3R.
3. Finish for Painted Steel Enclosures: Provide {CH#100934} unless otherwise indicated.
4. Positive electrical shutoff.
5. Wired from fan motor to junction box installed within motor compartment.

E. Roof Curb: {CH#100939} high{CH#100940} of {CH#100941} with continuously welded seams, {CH#100942}.

F. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

G. Options/Accessories:
1. Automatic Belt Tensioner: Automatic device that adjusts for correct belt tension for single drives.
2. Birdscreen:
a. Provide galvanized steel construction.
b. Protects fan discharge.
3. Clean Out Port: Removable grease repellent compression rubber plug allows access for cleaning wheel through windband.
4. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96.
5. Drain Connection:
a. Aluminum construction.
b. Allows single-point drainage of grease, water, or other residues.
6. Finishes: Factory primed.
7. Grease Trap:
a. Aluminum.
b. Includes drain connection.
c. Collects grease residue.
8. Hinge Kit:

a. Aluminum hinges.
b. Hinges and restraint cables mounted to base (sleeve).
c. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.

9. Heat Baffle: Prevents heat from radiating into motor compartment.
10. Tie-down Points: Four brackets located on windband secures fan in heavy wind applications.
11. External motor speed controllers for field mounting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Hung Cabinet Fans:
1. Install fans with resilient mountings and flexible electrical leads; see Section 230548.
2. Install flexible connections specified in Section 233300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

E. Provide sheaves required for final air balance.

F. Install backdraft dampers on inlet to roof and wall exhausters.

G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION

SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Diffusers:
   1. Critical environment diffusers.

B. Rectangular ceiling diffusers.
   1. Round ceiling diffusers.
   2. Slot ceiling diffusers.

C. Registers/grilles:
   1. Floor-mounted, linear supply register/grilles.
   2. Floor-mounted, supply register/grilles.
   3. Ceiling-mounted, egg crate exhaust and return register/grilles.
   4. Ceiling-mounted, exhaust and return register/grilles.
   5. Ceiling-mounted, linear exhaust and return register/grilles.
   6. Ceiling-mounted, supply register/grilles.
   7. Wall-mounted, supply register/grilles.
   8. Wall-mounted, linear register/grilles.

D. Wall and ceiling gypsum board access panels with return air grilles.

E. Duct-mounted supply and return registers/louvers.

F. Fabric air distribution devices.

G. Door grilles.

H. Louvers:

I. Louvered penthouses.

J. Roof hoods.

K. Goosenecks.

L. Gravity ventilators.

M. Fire-rated enclosures.

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS

A. AMCA 511 - Certified Ratings Program for Air Control Devices; 2010.

B. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2015, with Editorial Revision (2018).

C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (Reaffirmed 2021).

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2020.

E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

G. ISO 14644-1 - Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness by particle concentration; 2015.

H. UL 2518 - Standard for Safety Air Dispersion Systems; Current Edition, Including All Revisions.

I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

K. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

L. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Krueger-HVAC: www.krueger-hvac.com/#sle.

B. Metalaire, a brand of Metal Industries Inc: www.metalaire.com/#sle.

C. Price Industries: www.price-hvac.com/#sle.

D. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.

E. Substitutions: See Section 016000 - Product Requirements.

2.02 ROUND CEILING DIFFUSERS

A. Type: Round, adjustable pattern, stamped or spun, multi-core diffuser to discharge air in 360 degree pattern, with sectorizing baffles where indicated. Diffuser collar shall project not more than 1 inch above ceiling. In plaster ceilings, provide plaster ring and ceiling plaque.

B. Fabrication: Steel with baked enamel finish.

C. Color: As indicated on drawings.

D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.03 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square and rectangular, adjustable pattern diffuser to discharge air in four way pattern with sectorizing baffles where indicated.

B. Connections: Round.

C. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.

D. Fabrication: Steel with baked enamel finish.

E. Color: As indicated.

F. Accessories: Provide radial opposed blade, butterfly, and combination splitter volume control damper; removable core with damper adjustable from diffuser face.

2.04 CEILING SLOT DIFFUSERS

A. Type: Continuous 1/2 inch wide slot, 1 slots wide, with adjustable vanes for left, right, or vertical discharge.

B. Fabrication: Aluminum extrusions with factory clear lacquer finish.

C. Color: As indicated.

D. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket, mitered end border.

E. Plenum: Integral, galvanized steel, insulated.

2.05 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

A. Type: Duct-mounted, rectangular register for round-spiral duct with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.

B. Material: 22 gauge, 0.0299 inch.
   1. Provide crossing spiral fitting-body of matching duct diameter.

C. Color: As indicated on drawings.

2.06 CEILING SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Construction: Made of aluminum extrusions with factory enamel finish.

D. Color: As indicated.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.07 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.

B. Frame: 1-1/4 inch margin with countersunk screw mounting.

C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: As indicated.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.08 CEILING LINEAR EXHAUST AND RETURN GRILLES

A. Type: Streamlined blades with 90 degree one-way deflection, 1/8 by 3/4 inch on 1/4 inch centers.

B. Frame: 1-1/4 inch margin, extra heavy for floor mounting, with countersunk screw mounting.

C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: As indicated.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.09 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1 inch grid core.

B. Fabrication: Grid core consists of aluminum with mill aluminum finish.

C. Color: As indicated.

D. Frame: 1-1/4 inch margin with countersunk screw mounting.

E. Frame: Channel lay-in frame for suspended grid ceilings.

F. Accessories: Provide 45 degree angled eggcrate or other similar provisions for visual blocking such as angled louver, 90 degree duct elbow, etc..

2.10 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, double deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: As indicated.

E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

F. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.11 LINEAR WALL REGISTERS/GRILLES

A. Type: Streamlined blades with 0 degree deflection, 1/8 by 3/4 inch on 1/4 inch centers.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Aluminum extrusions, with factory baked enamel finish.

D. Color: As indicated.

E. Damper: Integral gang-operated opposed blade damper with removable key operator, operable from face.

2.12 LINEAR FLOOR SUPPLY REGISTERS/GRILLES

A. Type: Streamlined blades with 15 degree deflection, 1/8 by 3/4 inch on 1/4 inch centers, assembled on expanded tubes mandrel construction.

B. Frame: 1-1/4 inch heavy margin frame with countersunk screw mounting, and mounting frame.

C. Fabrication: Aluminum extrusions with factory baked enamel finish.

D. Color: As indicated.

E. Damper: Integral gang-operated opposed blade damper with removable key operator, operable from face.

2.13 CRITICAL ENVIRONMENTS DIFFUSERS

A. General Requirements:
   1. Diffuser material to comply with ASTM E84, UL 723, UL 2518, NFPA 90A, and NFPA 90B.

B. Laminar Flow Diffusers:
   1. Construction: Stainless steel.

2. Frame: Provide framing per manufacturer's recommendations.
3. Dimensions: As indicated.
4. Color: As indicated on drawings.
5. Damper: Provide volume control per manufacturer's recommendations.

2.14 FABRIC AIR DISTRIBUTION DEVICES

A. Manufacturers:
1. DuctSox Corporation: www.ductsox.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. General Requirements:
1. Diffuser material to comply with ASTM E84, UL 723, UL 2518, NFPA 90A, and NFPA 90B.
2. Fabrics to comply with ISO 14644-1 for ISO Class 4 application (clean room, non-shedding material).
3. Provide fabric air distribution devices made of 100 percent post-consumer recycled content polyester verified by a third party.
4. Fabric air distribution devices must be designed in software which documents, calculates and provides pressure loss, inlet velocity, turbulent condition warnings, throw capability, entrainment, deflection, flow models, sizing, installation methods, sound generated and temperature corrections.
5. Textile material must be documented to have the ability to dissipate static electricity (anti-static properties).

C. Continuous Diffusers:
1. Fabric: 100 percent flame retardant polyester treated with an antimicrobial agent from manufacturer.
2. Shape: Round.
3. Frame: Provide framing per manufacturer's recommendations.
4. Dimensions: As indicated.
5. Color: As indicated.

2.15 FLOOR SUPPLY REGISTERS/GRILLES

A. Individually adjustable blades, wide stamped border, single or double blade damper with set screw adjustment.

B. Fabricate of steel, welded construction, with factory baked enamel finish.

2.16 DOOR GRILLES

2.17 LOUVERS

A. Type: 6 inch deep with blades on 45 degree slope with center baffle and return bend, heavy channel frame, 1/2 inch square mesh screen over exhaust and 1/2 inch square mesh screen over intake.

B. Fabrication: 16 gauge, 0.0598 inch (1.52 mm) thick galvanized steel thick galvanized steel welded assembly, with factory prime coat finish.

C. Color: As indicated on the drawings.

D. Mounting: Furnish with exterior angle flange for installation.

2.18 LOUVERED PENTHOUSES

2.19 ROOF HOODS

A. Fabricate air inlet or exhaust hoods in accordance with SMACNA (DCS).

B. Fabricate of galvanized steel, minimum 16 gauge, 0.0598 inch base and 20 gauge, 0.0359 inch hood, or aluminum, minimum 16 gauge, 0.0598 inch base and 18 gauge, 0.0598 inch hood; suitably reinforced; with removable hood; birdscreen with 1/2 inch square mesh for exhaust and 3/4 inch for intake, and factory prime coat finish.

C. Fabricate louver penthouses with mitered corners and reinforce with structural angles.

D. Mount unit on minimum 12 inch high curb base with insulation between duct and curb.

E. Make hood outlet area minimum of twice throat area.

2.20 GOOSENECKS

A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.

B. Mount on minimum 12 inch high curb base where size exceeds 9 by 9 inch.

2.21 GRAVITY VENTILATORS

A. Hood Intake and Relief Gravity Ventilator:
   1. General:
      a. Low silhouette for intake applications with natural gravity or negative pressure system(s).
      b. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
      c. Suitable for non-ducted applications.
   2. Hood and Base:
      a. Material: Galvanized steel.
      b. Hood Construction: Precision formed, arched panels with interlocking seams.
      c. Vertical End Panels: Fully locked into hood end panels.
      d. Curb Cap: Pre-punched mounting holes for installation.
   3. Birdscreen:
      a. Fabricate in accordance with ASTM B221 (ASTM B221M).
      b. Construction: 1/2 inch Galvanized mesh.
      c. Horizontally mounted across hood intake area.
   4. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from the base or hinged open.
   5. Options/Accessories:
      a. Roof Curbs:
         1) Flat Roofs:
            (a) Welded, straight side curb with flashing flange and wood nailer.
            (b) Tabbed and riveted curb with 45 degree cant and wood nailer.
            (c) Welded curb with 45 degree cant and wood nailer.
         2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
         3) Material: Galvanized.
         4) Insulation Thickness: 1 inch.
      b. Provide extended base minimum 7 inch extension to base height making overall base 12 inches in height to prevent snow or moisture intake.
      c. Curb Seal: Rubber seal between fan and roof curb.
      d. Dampers:
         1) Type: Motorized.
         2) Factory designed to prevents outside air from entering back into building when fan is off.
         3) Balanced for minimal resistance to flow.
         4) Galvanized frames with pre-punched mounting holes.
      e. Factory Finish: Factory primed for field application of final finish.
      f. Hood Insulation or Coating: Provide 1/2 inch fiberglass insulation lining or anti-condensate coating to prevent condensation and reduce sound levels.
      g. Insect Screen:
         1) Fabricate in accordance with ASTM B221 (ASTM B221M).
         2) Construct of fine mesh aluminum.

3) Fitted to top of the throat to prevent entry of insects.
4) Coating: Thermo-setting polyester urethane.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

D. Install diffusers to ductwork with air tight connection.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

F. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 099123.

END OF SECTION

SECTION 234000
HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Activated carbon filters.

B. Disposable, extended area panel filters.

C. High efficiency particulate air (HEPA) filters.

1.02 REFERENCE STANDARDS

A. AHRI 851 (SI) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013 (Reaffirmed 2023).

B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017 (Amended (2020).

C. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; 2015b.

D. UL 586 - High Efficiency, Particulate, Air Filter Units; Current Edition, Including All Revisions.

E. UL 900 - Standard for Air Filter Units; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

C. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

D. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.

E. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

1.04 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 FILTER MANUFACTURERS

A. American Filtration Inc: www.americanfiltration.com/#sle.

B. AAF International/American Air Filter: www.aafintl.com/#sle.

C. The Camfil Group: www.camfilfarr.com/#sle.

D. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Comply with the rating requirements in AHRI 851 (SI).

2.03 ACTIVATED CARBON FILTERS

A. Assembly: Galvanized steel unit incorporating extruded aluminum tracks to accommodate filter servicing trays in deep V arrangement arranged for upstream servicing with disposable panel pre-filter.

B. Media:
   1. Activated Carbon Density: 34 lb/cu ft, pelletized or granular to 6 by 10 Tyler mesh screen.
   2. Carbon Tetrachloride Activity: Minimum 60 percent; in thin bed.

3. Trays: Nominal size 24 by 24 by 5/8 inches thick.
4. Carbon: 1.42 cu ft per 1000 CFM nominal air flow capacity.

2.04 DISPOSABLE, EXTENDED AREA PANEL FILTERS

A. Media: UL 900 Class 1, pleated, fine, glass fiber laminated to synthetic backing; supported and bonded to welded wire grid by corrugated aluminum separators.
   1. Frame: Non-flammable.

B. Minimum Efficiency Reporting Value (MERV): 8, when tested in accordance with ASHRAE Std 52.2.

C. Rating, per ASHRAE Std 52.2:

2.05 HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS

A. Media: UL 586, pleated, water-resistant glass fiber with separators of aluminum:
   1. Holding Frame: Galvanized steel.
   2. Media to Frame Side Bond: Polyurethane foam.
   3. Face Gasket: Neoprene expanded rubber.

B. Minimum Efficiency Reporting Value (MERV): 15, when tested in accordance with ASHRAE Std 52.2.

C. Performance Rating:
   1. MIL-STD-282 Test 0.3 Micron Dioctyl Phthalate Smoke (DOP) Efficiency: 99.97 percent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

END OF SECTION

SECTION 238200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic or steam baseboard radiation.

B. Hydronic or steam finned tube radiation.

C. Hydronic or steam convectors.

D. Hydronic or steam unit heaters.

E. Hydronic or steam cabinet unit heaters.

F. Fan-coil units.

G. Unit ventilators.

H. Electric baseboard heaters.

I. Electric unit heaters.

J. Electric cabinet unit heaters.

K. Blower-coil units.

L. Duct-mounted coils.

1.02 RELATED REQUIREMENTS

A. Section 230513 - Common Motor Requirements for HVAC Equipment.

B. Section 230913 - Instrumentation and Control Devices for HVAC.

C. Section 230993 - Sequence of Operations for HVAC Controls.

D. Section 232300 - Refrigerant Piping.

E. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

1.03 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.

B. AHRI 350 - Sound Performance Rating of Non-Ducted Indoor Air-Conditioning and Heat Pump Equipment; 2015.

C. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).

D. AHRI 440 - Performance Rating of Room Fan-Coils; 2008.

E. AHRI 840 - Unit Ventilators; 1998.

F. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

J. UL 674 - Electrical Motors and Generators for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:
   1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
   2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
   3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
   4. Submit the following for blower-coil units indicating:
      a. Overall dimensions including installation, operation, and service clearances.
      b. Lift points, recommendations, and center of gravity.
      c. Unit shipping, installation, and operating weights including dimensions.
      d. Fan curves with specified operating point clearly plotted.
      e. Safety and start-up instructions.

D. Selection Samples: For each finish product specified, color chart representing manufacturer's full range of available colors.

E. Verification Samples: For each finish product specified, color chip representing actual product in color and texture.

F. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

G. Manufacturer's Instructions: Indicate installation instructions and recommendations.

H. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.

I. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

J. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 HYDRONIC BASEBOARD RADIATION

A. Manufacturers:

1. Slant/Fin Corporation: www.slantfin.com/#sle.
2. Sterling Hydronics, a Mestek Company: www.sterlingheat.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Perform factory run test under normal operating conditions, water, and steam flow rates.

C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum or aluminum/copper fins.

D. Enclosure:
1. Steel material with high back and top, of one piece construction.
2. Removable front panel, end panel, end caps, corners, and joiner pieces.
3. Full length control damper.
4. Provisions for return piping.

E. Finish:
1. Factory applied, baked enamel finish.
2. Color: As selected from color chart.

F. Element Brackets: Galvanized or pre-painted steel supported from panel with non-metal element cradles or shoes, that allow for noise free expansion and contraction.

2.02 HYDRONIC FINNED TUBE RADIATION

A. Manufacturers:
1. Modine Manufacturing Company: www.modineHVAC.com/#sle.
2. Slant/Fin Corporation: www.slantfin.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Required Directory Listing: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.

C. Heating Elements: 1 inch ID seamless copper tubing, mechanically expanded into evenly spaced aluminum fins sized 4 by 4 inches, suitable for soldered fittings.

D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

E. Enclosures: 18 gage, 0.0478 inch sheet steel up to 18 inches in height, 16 gage, 0.0598 inch sheet steel over 18 inches in height, with easily jointed components for wall to wall installation.
1. Support rigidly, on wall or floor mounted brackets at least 3 feet on center maximum.

F. Finish: Factory applied baked enamel of color as selected.

G. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.

H. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 by 7 inch minimum size, integral with cabinet.

2.03 HYDRONIC CONVECTORS

A. Manufacturers:
1. Modine Manufacturing Company: www.modineHVAC.com/#sle.
2. Sterling Hydronics, a Mestek Company: www.sterlingheat.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Perform factory run test under normal operating conditions, water, and steam flow rates.

C. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins and cast iron headers, steel side plates and supports, factory air pressure tested at 100 psi under water, with means of adjusting pitch of element.

D. Cabinet: 16 gauge, 0.0598 inch sheet steel front and top, 18 gauge, 0.0478 inch sheet steel back and ends; exposed corners rounded; easily secured removable front panels, adequately braced and reinforced for stiffness.

E. Finish: Factory applied baked enamel of color as selected.

F. Damper: Where not thermostatically controlled, provide knob-operated internal damper at enclosure air outlet.

G. Access Doors: For otherwise inaccessible valves, provide factory-made permanently hinged access doors, 6 by 7 inch minimum size, integral with cabinet.

2.04 HYDRONIC UNIT HEATERS

A. Manufacturers:
   1. Modine Manufacturing Company: www.modineHVAC.com/#sle.
   2. Sterling Hydronics, a Mestek Company: www.sterlingheat.com/#sle.
   3. Trane Technologies, PLC; _____: www.trane.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

C. Perform factory run test under normal operating conditions, water, and steam flow rates.

D. Casing: Minimum 18 gauge, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gauge, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.

E. Finish: Factory applied baked enamel of color as selected.

F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

G. Air Outlet: Adjustable pattern diffuser on vertical projection models and two or four way louvers on horizontal projection models.

H. Totally Enclosed Motors: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models. See Section 230513

I. Explosion-Proof Motors:
   1. Comply with UL 674 for use in hazardous (classified) locations.
   2. Comply with NFPA 70 (National Electric Code) classification as follows:
      a. Class I, Group D; all sizes.
      b. Class II, Group F; all sizes.
      c. Class II, Group G; all sizes.
      d. Division I & II Installations.

J. Control: Local solid state disconnect switch with electropneumatic thermostat.

K. Electrical Characteristics:

2.05 HYDRONIC CABINET UNIT HEATERS

A. Manufacturers:
   1. Modine Manufacturing Company: www.modineHVAC.com/#sle.
   2. Sterling Hydronics a Mestek Company: www.sterlingheat.com/#sle.
   3. Trane, a brand of Ingersoll Rand: www.trane.com/#sle.
   4. Substitutions: See Section 016000 - Product Requirements.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose

indicated.

C. Coils:
   1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
   2. Heating Hot Water: Suitable for working temperatures up to a maximum not less than 200 degrees F.

D. Cabinet: Minimum 16 gauge, 0.0598 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.

E. Finish: Factory applied baked enamel of color as selected on visible surfaces of enclosure or cabinet.

F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

H. Control: Factory wired, solid state, infinite speed control, located in cabinet.

I. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.

J. Electrical Characteristics:

2.06 FAN-COIL UNITS

A. Manufacturers:
   1. Vertical Cabinet, Horizontal Exposed, or Horizontal Recessed:
      a. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp: www.commercial.carrier.com/#sle.
      b. Daikin Applied: www.daikinapplied.com/#sle.
      c. Krueger-HVAC: www.krueger-hvac.com/#sle.
      d. Trane, a brand of Ingersoll Rand: www.trane.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.
   2. Vertical Stack:
      a. Carrier Corporation: www.commercial.carrier.com/#sle.
      b. Daikin Applied: www.daikinapplied.com/#sle.
      c. International Environmental Corporation: www.iec-okc.com/#sle.
      d. Krueger-HVAC: www.krueger-hvac.com/#sle.
      e. Substitutions: See Section 016000 - Product Requirements.

B. Performance Data and Safety Requirements:
   1. Unit capacities certified in accordance with AHRI 440.
   2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
   3. Insulation to comply with NFPA 90A requirements for flame spread and smoke generation.
   4. Equipment wiring to comply with requirements of NFPA 70.

C. Required Directory Listings: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).

D. Coils:
   1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
   2. Water Coil: Suitable for working temperatures not less than 200 degrees F.
   3. Provide drain pan under cooling coil easily removable for cleaning.

E. Coil Piping Packages:

1. Manufacturers:
    a. Griswold Controls: www.griswoldcontrols.com/#sle.
    b. Hays Fluid Controls: www.haysfluidcontrols.com/#sle.
    c. Substitutions: See Section 016000 - Product Requirements.
2. Hoses:
    a. Provide hoses for all units for connection to main water supply and return headers.
    b. Length: 2 feet.

F. Vertical Cabinet and Horizontal Exposed Units: Minimum 18 gauge, 0.0478 inch thick sheet steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.
    a. Material: Braided stainless steel rated to minimum 400 psi at 265 degrees F.
2. Automatic Balancing Valves:
    a. Brass body for shutoff and hydronic balancing.
    b. Manufacturers:
        1) Hays Fluid Controls; Automatic Balancing Valves: www.haysfluidcontrols.com/#sle.
        2) Substitutions: See Section 016000 - Product Requirements.
3. Ball Valves:
    a. Brass body for shutoff and hydronic balancing.
    b. Provide pressure/temperature ports.
4. Y Strainers:
    a. Bronze body.
    b. "Y" type configuration with brass cap.
    c. Maximum Operating Pressure: Minimum 450 psi.
    d. Screen: Stainless steel.

G. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.

H. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

I. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

J. Controls:
1. Provide units with control valves furnished by the fan coil unit manufacturer.
2. Fan Coil Unit Manufacturer's Controls:
    a. Fan speed switch for unit mounting.
    b. Disconnect switch.
    c. Programmable thermostat.

K. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.

L. Electrical Characteristics:

2.07 UNIT VENTILATORS

A. Manufacturers:
1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.: www.commercial.carrier.com/#sle.
2. Daikin Applied: www.daikinapplied.com/#sle.
3. Trane, a brand of Ingersoll Rand: www.trane.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Performance Data and Safety Requirements:
1. Unit capacities certified and tested in accordance with AHRI 840 and AHRI 350.

2. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

C. Required Directory Listings: AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI).

D. Hydronic Coils:
1. Copper tubes mechanically expanded or bonded into evenly spaced aluminum fins.
2. Factory pressure tested, hydrostatically, to not less than 350 psi.
3. Provide insulated drain pan under chilled water coils, to prevent sweating, with field convertible left or right hand drain connections.

E. Refrigerant Coils:
1. Provide factory installed thermal expansion valves, properly sized to accommodate the selected condensing unit.
2. Factory proof and leak tested to ensure leak tight operation.
3. Provide insulated drain pan, to prevent condensation, with field convertible left or right hand connections.

F. Cabinet: 14 gauge, 0.0747 inch sheet steel on solid base pan with exposed edges rounded. Provide removable front panels with quick-acting, key-operated cam locks. Provide removable die-cast or fabricated steel discharge grilles. For units having cooling coils, insulate internal parts and surfaces exposed to conditioned air stream with moisture resistant insulation.

G. Cabinet Accessories: Matching steel construction, reinforced, for use with unit ventilators or finned radiation, with steel alignment pins, adjustable kick plates with leveling bolts, shelves and sliding doors with locks as indicated, sinks, bubbler faucets and bowls, corner, end, and wall filler sections as required.

H. Finish: Factory applied baked enamel of color as selected on visible surfaces of enclosure or cabinet.

I. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven, arranged to draw air through coil.

J. Wall Louvers: Anodized aluminum wall intake box and louvers removable from frame with 1/2 inch square mesh galvanized screen in back of louver.

K. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

L. Controls:
1. Provide units with control valves furnished by the unit ventilator manufacturer.
2. Unit Ventilator Manufacturer's Controls:
   a. Fan speed switch for unit mounting.
   b. Disconnect switch.
   c. Nonprogrammable thermostats.
3. Provide ASHRAE Cycle II as defined in ASHRAE (HVACA) Handbook - HVAC Applications.

M. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter air before coil.

N. Mixing Dampers: Multi-blade with compressible seal, capable of varying proportion of mixed air from 100 percent room air to 100 percent outside air.

O. Electrical Characteristics:

2.08 ELECTRIC BASEBOARD HEATERS

A. Manufacturers:
1. Marley Engineered Products: www.marleymep.com/#sle.

2. Vulcan Radiator, a Mestek Company: www.vulcanrad.com/#sle.
3. Substitutions: See Section 016000 - Product Requirements.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

C. Heater Assembly:

D. Heating Elements:
1. Enclosed nickel chromium wire in steel, stainless steel, or aluminum sheathing or tubing.
2. Mechanically bonded, aluminum finned, heating elements.
3. Heating element securely anchored and free-floating for noise free operation.

E. Enclosure Requirements:
1. General: 24 gauge, 0.0239 inch steel, minimum. Typical for panels, end-caps, corners, joiner pieces, and other related items. Joints to snap together without fasteners.
2. Service Access Panels: Impact resistant; factory configure for easy removal.

F. Finish:
1. Factory applied, baked enamel finish.
2. Color: As indicated on drawings.

G. Controls: Internal bi-metal element thermostat, factory wired.

H. Electrical Characteristics:

2.09 ELECTRIC UNIT HEATERS

A. Manufacturers:
1. INDEECO (Industrial Engineering and Equipment Company): www.indeeco.com/#sle.
2. Modine Manufacturing Company: www.modineHVAC.com/#sle.
3. Trane, a brand of Ingersoll Rand: www.trane.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

C. Heating Element Assembly:
1. Thermal safety cut-out within electric terminal box with automatically reset switch located near electric terminal box.
2. Horizontal Projection Units:

D. Housing:
1. Suitable for ceiling or high altitude mount using provided hardware appendages.
2. Horizontal Projection Units:
   a. Construction materials to consist of heavy gage steel with galvanized, polyester powder coat, or high gloss baked enamel finish.
   b. Provide with threaded holes for threaded rod suspension.
   c. Provisions for access to internal components for maintenance, adjustments, and repair.

E. Air Inlets and Outlets:
1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
2. Outlets: Provide diffuser cones, directional louvers, or radial diffusers.

F. Fan: Factory balanced, direct drive, axial type with fan guard.

G. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.

H. Controls:
   1. Built-in line-voltage thermostat.

I. Electrical Characteristics:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

3.03 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Unit Heaters:
   1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
   2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

E. Cabinet Unit Heaters:
   1. Install as indicated.
   2. Coordinate to ensure correct recess size for recessed units.

F. Fan-Coil Units:
   1. Install as indicated.
   2. Coordinate to ensure correct recess size for recessed units.

G. Unit Ventilators:
   1. Locate as indicated, level and shim units, and anchor to structure.
   2. Coordinate exact location of wall louvers.
   3. Provide wall trim pieces for continuous wall-to-wall installation.

H. Units with Hydronic Coils:
   1. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping.
   2. If not easily accessible, extend air vent to exterior surface of cabinet for ease of servicing.
   3. Provide float operated automatic air vents with stop valve for cabinet unit heaters, fan coil units, and unit heaters.

I. Units with Cooling Coils: Connect drain pan to condensate drain.

J. Blower-Coil Units:
   1. Verify all surfaces and openings at unit location can suitably accommodate unit(s).
   2. Install in accordance with manufacturer's recommendations.
   3. Provide manual shut-off valve on hydronic supply side of coil and balancing valve with memory stop on return side.
   4. General piping installation requirements are specified in other Sections and drawings indicate general arrangement of piping, fittings, and specialties.
   5. Connect hydronic, condensate drain, and overflow drain piping to unit.

K. Air Coils:
   1. Install in ducts and casings in accordance with SMACNA (DCS).
      a. Support coil sections independent of piping on steel channel or double angle frames and secure to casing.

b. Provide frames for maximum of three coil sections.
c. Arrange supports to avoid piercing drain pans.
d. Provide airtight seals between coil and casing or duct.

2. Coil Safeguards:
   a. Protect coils to prevent damage to flanges and fins.
   b. Comb out damaged fins.
3. Install all coils level except cleanable coils with 1:50 pitch.
4. Make connections to hydronic and steam coils with unions and flanges.
5. Hydronic (Drainable) Coils:
   a. Connect water supply to leaving air side of coil (counterflow arrangement).
   b. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping.
   c. Locate supply water connection on leaving air side at bottom of supply header, and return water connection at top.
   d. Provide manual air vents with stop valves at high points.
      1) Install drain connections at low points of installation.
6. Cooling Coils:
   a. Provide three break or six break moisture eliminators of galvanized 24 gauge, 0.0239 inch sheet steel, where air velocity exceeds 500 ft/min.
   b. Cooling Condensate Drain Pan and Drain Connection:
      1) Fabricate from galvanized 20 gauge, 0.0359 inch sheet steel, extend 3 inches from face of entering air side, 6 inches from the face of the leaving air side, and 4 inches from the face of moisture eliminators.
      2) Design slope in accordance with ASHRAE Std 62.1 and install to prevent standing water.
      3) Pipe drains individually to floor drain with water seal trap.
   c. Install condensate drain pan under each main cooling coil and intermediate condensate drain pan at each level of stacked cooling coils to collect all condensate from coil assembly, pipe header, pipe return bends, upstream run-off, and downstream carry-over.
7. Refrigerant Coils:
   a. Provide sight glass in liquid line within 12 inches of coil.
   b. See Section 232300.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Provide manufacturer's field representative to inspect.

3.05 CLEANING

A. After construction and painting is completed, clean exposed surfaces of units.

B. Vacuum clean coils and inside of units.

C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

D. Install new filters.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017800 - Closeout Submittals for closeout submittals.

B. See Section 017900 - Demonstration and Training for additional requirements.

3.07 PROTECTION

A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION

SECTION 260505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Owner before disturbing existing installation.

E. Report discrepancies to Architect before disturbing existing installation.

F. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
   2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner before partially or completely disabling system.
   2. Make notifications at least 24 hours in advance.
   3. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Notify Owner at least 24 hours before partially or completely disabling system.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
   2. PCB- and DEHP-containing lighting ballasts.

3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

END OF SECTION

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Nonmetallic-sheathed cable.
C. Underground feeder and branch-circuit cable.
D. Service entrance cable.
E. Armored cable.
F. Metal-clad cable.
G. Power and control tray cable.
H. Manufactured wiring systems.
I. Wiring connectors.
J. Electrical tape.
K. Heat shrink tubing.
L. Oxide inhibiting compound.
M. Wire pulling lubricant.
N. Cable ties.
O. Firestop sleeves.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.
B. Section 260505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 260519.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.
D. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
E. Section 260536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
G. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
H. Section 263100 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.
I. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.
J. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Manufactured wiring systems are permitted only as follows:
   1. Where not otherwise restricted, may be used:
      a. For branch circuits where concealed under raised floors, where concealed above accessible ceilings for lighting, and in open ceiling areas for lighting.
         1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductor Material:
   1. Provide copper conductors except where aluminum conductors are specifically indicated. Substitution of aluminum conductors for copper is not permitted. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
   2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
   3. Tinned Copper Conductors: Comply with ASTM B33.
   4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.

H. Minimum Conductor Size: 12 AWG.

I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

J. Conductor Color Coding:
   1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
   2. Color Coding Method: Integrally colored insulation.
   3. Color Code:
      a. 480Y/277 V, 3 Phase, 4 Wire System:
         1) Phase A: Brown.
         2) Phase B: Orange.
         3) Phase C: Yellow.
         4) Neutral/Grounded: Gray.
      b. 208Y/120 V, 3 Phase, 4 Wire System:
         1) Phase A: Black.
         2) Phase B: Red.
         3) Phase C: Blue.

4) Neutral/Grounded: White.

c. 240/120 V High-Leg Delta, 3 Phase, 4 Wire System:
   1) Phase A: Black.
   2) Phase B (High-Leg): Orange.
   3) Phase C: Blue.
   4) Neutral/Grounded: White.

d. Equipment Ground, All Systems: Green.

e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

2.03 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:
   1. Copper Building Wire:
      a. Cerro Wire LLC: www.cerrowire.com/#sle.
      b. Encore Wire Corporation: www.encorewire.com/#sle.
      c. General Cable Technologies Corporation: www.generalcable.com/#sle.
      d. Southwire Company: www.southwire.com/#sle.
   2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):
      a. Encore Wire Corporation: www.encorewire.com/#sle.
      b. Southwire Company: www.southwire.com/#sle.
      c. Stabiloy, a brand of General Cable Technologies Corporation: www.stabiloy.com/#sle.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:
   1. Feeders and Branch Circuits:
      a. Size 10 AWG and Smaller: Solid.
      b. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:
   1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
      a. Size 4 AWG and Larger: Type XHHW-2.
      b. Installed Underground: Type XHHW-2.

2.04 NONMETALLIC-SHEATHED CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.
   2. Encore Wire Corporation: www.encorewire.com/#sle.
   3. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.

C. Conductor Stranding:
   1. Size 10 AWG and Smaller: Solid.
   2. Size 8 AWG and Larger: Stranded.

D. Insulation Voltage Rating: 600 V.

2.05 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

A. Manufacturers:
   1. Cerro Wire LLC: www.cerrowire.com/#sle.

2. Encore Wire Corporation: www.encorewire.com/#sle.
3. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.

C. Provide equipment grounding conductor unless otherwise indicated.

D. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

E. Insulation Voltage Rating: 600 V.

F. Cable Jacket: Listed and labeled as sunlight resistant.

2.06 SERVICE ENTRANCE CABLE

A. Manufacturers:
1. Copper Service Entrance Cable:
a. Cerro Wire LLC: www.cerrowire.com/#sle.
b. Encore Wire Corporation: www.encorewire.com/#sle.
c. Southwire Company: www.southwire.com/#sle.
2. Aluminum Service Entrance Cable:
a. Encore Wire Corporation: www.encorewire.com/#sle.
b. General Cable Technologies Corporation: www.generalcable.com/#sle.
c. Southwire Company: www.southwire.com/#sle.
d. Stabiloy, a brand of General Cable Technologies Corporation: www.stabiloy.com/#sle.

B. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: 600 V.

2.07 POWER AND CONTROL TRAY CABLE

A. Manufacturers:
1. Encore Wire Corporation: www.encorewire.com/#sle.
2. General Cable Technologies Corporation: www.generalcable.com/#sle.
3. Okonite: www.okonite.com/#sle.
4. Southwire Company: www.southwire.com/#sle.

B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.

C. Conductor Stranding: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type XHHW or XHHW-2.

F. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.08 MANUFACTURED WIRING SYSTEMS

A. Manufacturers:
1. AFC Cable Systems Inc: www.afcweb.com/#sle.
2. D&P Custom Lights & Wiring Systems, Inc: www.dandpcustomlights.com/#sle.
3. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com/#sle.
4. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Description: Manufactured wiring assemblies complying with NFPA 70 Article 604, and listed and labeled as complying with UL 183.

C. Provide components necessary to transition between manufactured wiring system and other wiring methods.

D. Branch Circuit Cables:
   1. Conductor Stranding (Size 10 AWG and Smaller): Solid.
   2. Insulation Voltage Rating: 600 V.
   3. Insulation: Type THHN.
   4. Grounding: Full-size integral equipment grounding conductor.
   5. Armor: Steel, interlocked tape.

E. Connectors: Keyed and color-coded to prevent interconnection of different voltages.

F. Fixture Leads: Type TFN insulation.

2.09 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 260526.

C. Wiring Connectors for Splices and Taps:
   1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
   2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:
   1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
   2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
   3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
   4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
   5. Aluminum Conductors: Use compression connectors for all connections.

E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Mechanical Connectors: Provide bolted type or set-screw type.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ilsco: www.ilsco.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.

2.10 ACCESSORIES

A. Electrical Tape:
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
   2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
   3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
   4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
   1. Manufacturers:
      a. 3M: www.3m.com/#sle.
      b. Burndy LLC: www.burndy.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
   1. Manufacturers:
      a. Burndy LLC: www.burndy.com/#sle.
      b. Ideal Industries, Inc: www.idealindustries.com/#sle.
      c. Ilsco: www.ilsco.com/#sle.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

E. Cable Ties: Material and tensile strength rating suitable for application.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   3. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   4. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
      a. Increase size of conductors as required to account for ampacity derating.
   5. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install aluminum conductors in accordance with NECA 104.

E. Install nonmetallic-sheathed cable (Type NM-B) in accordance with NECA 121.

F. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.

G. Install metal-clad cable (Type MC) in accordance with NECA 120.

H. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

I. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

J. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

K. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

L. Install conductors with a minimum of 12 inches of slack at each outlet.

M. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

N. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

O. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
   6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

P. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

Q. Insulate ends of spare conductors using vinyl insulating electrical tape.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

END OF SECTION

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 260536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 263100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.

E. Section 264113 - Lightning Protection for Structures.

F. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2017.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 99 - Health Care Facilities Code; 2018.

G. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2020.

H. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Concrete-Encased Electrode:
      a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
   3. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
   4. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
      a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
      b. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

G. Separately Derived System Grounding:
   1. Separately derived systems include, but are not limited to:
      a. Transformers (except autotransformers such as buck-boost transformers).

b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
c. Generators, when neutral is switched in the transfer switch.

2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

H. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for metal building frame.
8. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.

I. Isolated Ground System:
1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

J. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.

K. Lightning Protection Systems, in Addition to Requirements of Section 264113:

1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.
2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.

L. Cable Tray Systems: Also comply with Section 260536.

M. Photovoltaic Systems: Also comply with Section 263100.

N. Pole-Mounted Luminaires: Also comply with Section 265600.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:
1. Use insulated copper conductors unless otherwise indicated.
a. Exceptions:
1) Use bare copper conductors where installed underground in direct contact with earth.
2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury

horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

D. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.13.

D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.02 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.03 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
   2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
   3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
   4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
   5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
      a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
      b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
   1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
   2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
   1. Comply with MFMA-4.

E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

F. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

END OF SECTION

SECTION 260533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).
B. Aluminum rigid metal conduit (RMC).
C. Intermediate metal conduit (IMC).
D. PVC-coated galvanized steel rigid metal conduit (RMC).
E. Flexible metal conduit (FMC).
F. Liquidtight flexible metal conduit (LFMC).
G. Electrical metallic tubing (EMT).
H. Rigid polyvinyl chloride (PVC) conduit.
I. Electrical nonmetallic tubing (ENT).
J. Liquidtight flexible nonmetallic conduit (LFNC).
K. Conduit fittings.
L. Accessories.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
   4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.

B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.

C. Underground:
   1. Under Slab on Grade: Use rigid PVC conduit.
   2. Exterior, Direct-Buried: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.
   3. Exterior, Embedded Within Concrete: Use PVC-coated galvanized steel rigid metal conduit or rigid PVC conduit.

D. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).

E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).

F. Interior, Damp or Wet Locations: Use electrical metallic tubing (EMT).

G. Exposed, Interior, Not Subject to Physical Damage: Use electrical metallic tubing (EMT).

H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

I. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), aluminum rigid metal conduit, or PVC-coated galvanized steel rigid metal conduit.

J. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
   1. Maximum Length: 6 feet.

K. Connections to Vibrating Equipment:
   1. Dry Locations: Use flexible metal conduit.
   2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
   3. Maximum Length: 6 feet unless otherwise indicated.

2.02 CONDUIT REQUIREMENTS

A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.

B. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 1/2 inch (16 mm) trade size.
   2. Branch Circuit Homeruns: 1/2 inch (16 mm) trade size.
   3. Control Circuits: 1/2 inch (16 mm) trade size.
   4. Flexible Connections to Luminaires: 3/8 inch (12 mm) trade size.
   5. Underground, Interior: 3/4 inch (21 mm) trade size.
   6. Underground, Exterior: 1 inch (27 mm) trade size.

E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.

3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
   4. Material: Use aluminum.
   5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.05 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
    a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.06 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:
    1. Thomas & Betts Corporation: www.tnb.com/#sle.
    2. Robroy Industries: www.robroy.com/#sle.

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.

D. PVC-Coated Fittings:
    1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
    2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
    3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
    4. Material: Use steel or malleable iron.
    5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.

E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.07 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:
    1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
    2. Electri-Flex Company: www.electriflex.com/#sle.
    3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:
    1. Manufacturers:
        a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
        b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
        c. Thomas & Betts Corporation: www.tnb.com/#sle.
    2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
    3. Material: Use steel or malleable iron.

2.08 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:
    1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
    2. Electri-Flex Company: www.electriflex.com/#sle.
    3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:
    1. Manufacturers:
        a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.

b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
c. Thomas & Betts Corporation: www.tnb.com/#sle.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
   a. Do not use die cast zinc fittings.

2.09 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:
   1. Allied Tube & Conduit: www.alliedeg.com/#sle.
   2. Republic Conduit: www.republic-conduit.com/#sle.
   3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:
   1. Manufacturers:
      a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
      b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
      c. Thomas & Betts Corporation: www.tnb.com/#sle.
   2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
   3. Material: Use steel or malleable iron.
      a. Do not use die cast zinc fittings.
   4. Connectors and Couplings: Use compression (gland) or set-screw type.
      a. Do not use indenter type connectors and couplings.
   5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Manufacturers:
   1. Cantex Inc: www.cantexinc.com/#sle.
   2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
   3. JM Eagle: www.jmeagle.com/#sle.

B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.
   2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

A. Manufacturers:
   1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
   2. Electri-Flex Company: www.electriflex.com/#sle.
   3. International Metal Hose: www.metalhose.com/#sle.

B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.

C. Fittings:
   1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.

E. Install intermediate metal conduit (IMC) in accordance with NECA 101.

F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.

G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.

H. Install liquidtight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.

I. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   4. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   5. Use conduit clamp to support single conduit from beam clamp or threaded rod.
   6. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
   7. Use of wire for support of conduits is not permitted.

J. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
   2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
   3. Use suitable adapters where required to transition from one type of conduit to another.
   4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
   5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
   6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
   7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
3. Where conduits are subject to earth movement by settlement or frost.

M. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Provide grounding and bonding in accordance with Section 260526.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.

D. Correct deficiencies and replace damaged or defective conduits.

3.04 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 260533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes and enclosures for integrated power, data, and audio/video.

D. Boxes for hazardous (classified) locations.

E. Floor boxes.

F. Underground boxes/enclosures.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.
   7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
   8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
   1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
   2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
   3. Provide products listed, classified, and labeled as suitable for the purpose intended.
   4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
   5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
   1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
   2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
   3. Use suitable concrete type boxes where flush-mounted in concrete.
   4. Use suitable masonry type boxes where flush-mounted in masonry walls.
   5. Use raised covers suitable for the type of wall construction and device configuration where required.
   6. Use shallow boxes where required by the type of wall construction.
   7. Do not use "through-wall" boxes designed for access from both sides of wall.
   8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
   9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
   10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
   11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
   12. Minimum Box Size, Unless Otherwise Indicated:
      a. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
   13. Wall Plates: Comply with Section 262726.
   14. Manufacturers:
      a. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
      c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
      d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
   1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
   2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   3. Junction and Pull Boxes Larger Than 100 cubic inches:
      a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
   4. Manufacturers:
      a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
      b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
      c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.

D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
   1. Manufacturers:
      a. Hubbell Incorporated: www.hubbell.com/#sle.

E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
   1. Manufacturers:
      a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.
      b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.

c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.

F. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Use sheet-steel or cast iron floor boxes within slab above grade.
3. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
4. Manufacturer: Same as manufacturer of floor box service fittings.

G. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
2. Size: As indicated on drawings.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
4. Applications:
a. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
a. Manufacturers:
1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
2) MacLean Highline: www.macleanhighline.com/#sle.
3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
c. Product(s):
1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
(a) 11 by 18 by 12 inches nominal; Model PHA111812 (stackable).
2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
(a) 11 by 18 by 12 inches nominal; Model CHA111812.
3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.
(a) 30 by 48 by 18 inches nominal; Model CVA304818.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

E. Install boxes plumb and level.

F. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

G. Install boxes as required to preserve insulation integrity.

H. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

I. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

J. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

K. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

L. Close unused box openings.

M. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

N. Provide grounding and bonding in accordance with Section 260526.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 260533.23
SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface raceway systems.

B. Wireways.

C. Wall duct.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260533.13 - Conduit for Electrical Systems.

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section 260539 - Underfloor Raceways for Electrical Systems: Trench duct.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 262723 - Indoor Service Poles.

H. Section 262726 - Wiring Devices: Receptacles.

I. Section 271000 - Structured Cabling: Voice and data jacks.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway; 2015.

D. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.

E. UL 5A - Nonmetallic Surface Raceways and Fittings; Current Edition, Including All Revisions.

F. UL 111 - Outline of Investigation for Multioutlet Assemblies; Current Edition, Including All Revisions.

G. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate rough-in locations of outlet boxes provided under Section 260533.16 and conduit provided under Section 260533.13 as required for installation of raceways provided under this section.
   3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
   4. Wall Duct: Coordinate the work with other trades to provide walls suitable for installation of flush-mounted wall duct where indicated.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install raceways until final surface finishes and painting are complete.

2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
   1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 RACEWAY REQUIREMENTS

A. Provide all components, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. MonoSystems, Inc: www.monosystems.com/#sle.
   3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Surface Metal Raceways: Listed and labeled as complying with UL 5.

C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.

D. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

2.03 WIREWAYS

A. Manufacturers:
   1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
   2. Enduro Composites: www.endurocomposites.com/#sle.
   3. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
   4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.

C. Wireway Type, Unless Otherwise Indicated:

D. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.04 WALL DUCT

A. Manufacturers:
   1. Dennis Filges Company, Inc: www.filgesco.com/#sle.
   2. Hubbell Incorporated: www.hubbell.com/#sle.
   3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

4. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Description: Metal raceways specifically designed for enclosure of wiring to X-ray machines and similar medical equipment; listed and labeled as complying with UL 870.

C. Material: Steel, unless otherwise indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install raceways plumb and level.

D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.

E. Secure and support raceways in accordance with Section 260529 at intervals complying with NFPA 70 and manufacturer's requirements.

F. Close unused raceway openings.

G. Provide grounding and bonding in accordance with Section 260526.

3.02 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.03 PROTECTION

A. Protect installed raceways from subsequent construction operations.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

B. Section 262300 - Low-Voltage Switchgear: Factory-installed mimic bus.

C. Section 271000 - Structured Cabling: Identification for communications cabling and devices.

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2021.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    a. Switchgear:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
    b. Switchboards:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
    c. Panelboards:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
        5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
    d. Transformers:
        1) Identify kVA rating.
        2) Identify voltage and phase for primary and secondary.
    e. Enclosed switches, circuit breakers, and motor controllers:
        1) Identify voltage and phase.
    f. Enclosed Contactors:
        1) Identify ampere rating.
        2) Identify voltage and phase.
    g. Centralized Emergency Lighting Inverters:
        1) Identify input and output voltage and phase.
    h. Transfer Switches:
        1) Identify voltage and phase.
        2) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
2. Service Equipment:
    a. Use identification nameplate to identify each service disconnecting means.
3. Emergency System Equipment:
    a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
    b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
4. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    a. Service equipment.
    b. Industrial control panels.
    c. Motor control centers.

d. Elevator control panels.
e. Industrial machinery.

5. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
   a. Minimum Size: 3.5 by 5 inches.
   b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
   c. Service Equipment: Include the following information in accordance with NFPA 70.
      1) Nominal system voltage.
      2) Available fault current.
      3) Date label applied.

B. Identification for Conductors and Cables:
   1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
   2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Manufacturers:
      a. Brimar Industries, Inc: www.brimar.com/#sle.
      b. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
      c. Seton Identification Products: www.seton.com/#sle.
   2. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
   3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
   4. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

2.03 WIRE AND CABLE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. HellermannTyton: www.hellermanntyton.com/#sle.
   3. Panduit Corp: www.panduit.com/#sle.

B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

D. Legend: Power source and circuit number or other designation indicated.

E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

F. Minimum Text Height: 1/8 inch.

G. Color: Black text on white background unless otherwise indicated.

2.04 VOLTAGE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradyid.com/#sle.
   2. Brimar Industries, Inc: www.brimar.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.

B. Minimum Size:
   1. Markers for Equipment: 1 1/8 by 4 1/2 inches.

C. Legend:

D. Color: Black text on orange background unless otherwise indicated.

2.05 WARNING SIGNS AND LABELS

A. Manufacturers:
   1. Brimar Industries, Inc: www.brimar.com/#sle.
   2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
   3. Seton Identification Products: www.seton.com/#sle.

B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

C. Warning Signs:
   1. Materials:
   2. Minimum Size: 7 by 10 inches unless otherwise indicated.

D. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Conductors and Cables: Legible from the point of access.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Mark all handwritten text, where permitted, to be neat and legible.

END OF SECTION

SECTION 260573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

B. Section 262100 - Low-Voltage Electrical Service Entrance.

C. Section 262300 - Low-Voltage Switchgear.

D. Section 262413 - Switchboards.

E. Section 262416 - Panelboards.

F. Section 262419 - Motor-Control Centers.

G. Section 262513 - Low-Voltage Busways.

H. Section 262813 - Fuses.

I. Section 262816.13 - Enclosed Circuit Breakers.

J. Section 262816.16 - Enclosed Switches.

1.03 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

B. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).

C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).

D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.

E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.

F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).

G. NEMA MG 1 - Motors and Generators; 2018.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2021.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Submit study reports prior to or concurrent with product submittals.
2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

C. Scheduling:
1. Arrange access to existing facility for data collection with Owner.
2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Study preparer's qualifications.

C. Field testing agency's qualifications.

D. Study reports, stamped or sealed and signed by study preparer.

E. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
1. Include characteristic time-current trip curves for protective devices.
2. Include impedance data for busway.
3. Include impedance data for engine generators.
4. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
5. Include documentation of listed series ratings upon request.
6. Identify modifications made in accordance with studies that:
   a. Can be made at no additional cost to Owner.
   b. As submitted will involve a change to the contract sum.

F. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

G. Site-specific arc flash hazard warning labels.

H. Field quality control reports.

I. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

J. Project Record Documents: Revise studies as required to reflect as-built conditions.
1. Include hard copies with operation and maintenance data submittals.
2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
1. Perform analysis of new electrical distribution system as indicated on drawings.
2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment

involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).

3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
    a. Known Operating Modes:
        1) Utility as source.
        2) Generator as source.

B. General Study Requirements:
1. Comply with NFPA 70.
2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
        1) Obtain up-to-date information from Utility Company.
        2) Utility Company: As indicated on drawings.
    b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
    c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
    d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
    e. Protective Devices:
        1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
        2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
    f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
    g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
    a. Maximum utility fault currents.
    b. Maximum motor contribution.
    c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
1. Comply with applicable portions of IEEE 242 and IEEE 399.

2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.

F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
   a. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
   b. For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584 using single phase bolted fault current, yielding conservative results.
3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
   a. Maximum and minimum utility fault currents.
   b. Maximum and minimum motor contribution.
   c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
1. General Requirements:
   a. Identify date of study and study preparer.
   b. Identify study methodology and software product(s) used.
   c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
   d. Identify base used for per unit values.
   e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
   f. Include conclusions and recommendations.
2. Short-Circuit Study:
   a. For each scenario, identify at each bus location:
      1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      2) Fault point X/R ratio.
      3) Associated equipment short circuit current ratings.
   b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
   a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
   b. For each graph include (where applicable):
      1) Partial single-line diagram identifying the portion of the system illustrated.
      2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
      3) Conductors: Damage curves.
      4) Transformers: Inrush points and damage curves.

5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
6) Motors: Full load current, starting curves, and damage curves.
7) Capacitors: Full load current and damage curves.

c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
2) Include ground fault pickup and delay.
3) Include fuse ratings.
4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.

d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.

4. Arc Flash and Shock Risk Assessment:
a. For the worst case for each scenario, identify at each bus location:
1) Calculated incident energy and associated working distance.
2) Calculated arc flash boundary.
3) Bolted fault current.
4) Arcing fault current.
5) Clearing time.
6) Arc gap distance.

b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

1.07 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
2. Study preparer may be employed by field testing agency.

B. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.

C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
1. Acceptable Software Products:
a. EasyPower LLC: www.easypower.com/#sle.
b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
c. Power Analytics Corporation: www.poweranalytics.com/#sle.
d. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.01 ARC FLASH HAZARD WARNING LABELS

A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
1. Materials: Comply with Section 260553.

2. Minimum Size: 4 by 6 inches.
3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
    a. Include orange header that reads "WARNING" unless otherwise indicated.
    b. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
    c. Include the following information:
        1) Arc flash boundary.
        2) Available incident energy and corresponding working distance.
        3) Site-specific PPE (personnel protective equipment) requirements.
        4) Nominal system voltage.
        5) Limited approach boundary.
        6) Restricted approach boundary.
        7) Equipment identification.
        8) Date calculations were performed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install arc flash warning labels in accordance with Section 260553.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Adjust equipment and protective devices for compliance with studies and recommended settings.

E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.03 CLOSEOUT ACTIVITIES

A. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
    1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
    2. Location: At project site.

END OF SECTION

SECTION 260583
WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 260533.13 - Conduit for Electrical Systems.

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 262726 - Wiring Devices.

E. Section 262816.16 - Enclosed Switches.

F. Section 262913 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
   1. Colors: Comply with NEMA WD 1.
   2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
   3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.

C. Wiring Devices: As specified in Section 262726.

D. Flexible Conduit: As specified in Section 260533.13.

E. Wire and Cable: As specified in Section 260519.

F. Boxes: As specified in Section 260533.16.

2.02 EQUIPMENT CONNECTIONS

A.

1. Electrical Connection: Flexible conduit.
2. Electrical Connection: Cord and plug (NEMA 6-20R).
3. Provide field-installed disconnect switch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Occupancy sensors.
B. Outdoor motion sensors.
C. Time switches.
D. In-wall time switches.
E. Outdoor photo controls.
F. Daylighting controls.
G. Lighting contactors.
H. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 253626 - Integrated Automation Lighting Relays.
B. Section 260526 - Grounding and Bonding for Electrical Systems.
C. Section 260529 - Hangers and Supports for Electrical Systems
D. Section 260533.16 - Boxes for Electrical Systems.
E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
F. Section 260918 - Remote Control Switching Devices: Remotely controlled devices for lighting control, including networked lighting controls, programmable relay panels, and remote control switching relays.
G. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.
H. Section 262813 - Fuses.
I. Section 262913 - Enclosed Controllers : General purpose contactors.
J. Section 265100 - Interior Lighting.
K. Section 265561 - Theatrical Lighting: Controls for stage lighting units.
L. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.
B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.
C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2004 (R2010).
D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
G. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).
H. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.

K. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

L. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

M. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

N. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

O. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

P. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
   3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
   4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
   5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

C. Field Quality Control Reports.

D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Include detailed information on device programming and setup.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for all occupancy sensors.

C. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

2.02 OCCUPANCY SENSORS

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
   3. Sensor Switch Inc: www.sensorswitch.com/#sle.
   4. WattStopper: www.wattstopper.com/#sle.

B. All Occupancy Sensors:
   1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
   2. Sensor Technology:
      a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
      b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
      c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
   3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
   4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
   5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
   6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
   7. Sensitivity: Field adjustable.
   8. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
   9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load

requirements.

10. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
11. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
12. Wireless Sensors:
    a. RF Range: 30 feet through typical construction materials.
    b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
    c. Power: Battery-operated with minimum ten-year battery life.

C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    b. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
3. Ultrasonic Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 400 square feet.
4. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

D. Wall Dimmer Occupancy Sensors:
1. General Requirements:
    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
    b. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

E. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
    a. Description: Low profile occupancy sensors designed for ceiling installation.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
    a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
    a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
    c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:

a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.

5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.

F. Directional Occupancy Sensors:
1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
2. Passive Infrared (PIR) Directional Occupancy Sensors:
a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
b. Long Range Sensors: Capable of detecting motion within a distance of 80 feet at a mounting height of 10 feet.
c. High Bay Sensors: Capable of detecting motion within a distance of 50 feet at a mounting height of 30 feet.
3. Passive Infrared/Ultrasonic Dual Technology Directional Occupancy Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.

G. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.

H. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.

I. Power Packs for Wireless Occupancy Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Rating: As required to control the load indicated on drawings.

2.03 OUTDOOR MOTION SENSORS

A. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.

B. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

C. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.

D. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.

E. Integral Photocell: For dusk to dawn operation.

F. Manual Override: Activated by switching power off to unit and then back on.

G. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.

H. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

2.04 TIME SWITCHES

A. Manufacturers:
   1. Intermatic, Inc: www.intermatic.com/#sle.
   2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.

B. Digital Electronic Time Switches:
   1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
   2. Program Capability:
   3. Schedule Capacity: Not less than 16 programmable on/off operations.
   4. Provide automatic daylight savings time and leap year compensation.
   5. Provide power outage backup to retain programming and maintain clock.
   6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
   7. Input Supply Voltage: As indicated on the drawings.
   8. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

C. Electromechanical Time Switches:
   1. Description: Factory-assembled controller with motor-operated timing dial mechanism and adjustable trippers for setting on/off operations, listed and labeled as complying with UL 917.
   2. Program Capability:
      a. Astronomic Time Switches: With same schedule for each day of the week and skip-a-day feature to omit selected days with automatic adjustment for seasonal changes in sunrise and sunset times.
   3. Schedule Capacity:
      a. Astronomic Time Switches: Capable of turning load on at sunset and off at either sunrise or selected fixed time.
   4. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
   5. Input Supply Voltage: As indicated on the drawings.
   6. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

2.05 OUTDOOR PHOTO CONTROLS

A. Stem-Mounted Outdoor Photo Controls:
   1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
   2. Housing: Weatherproof, impact resistant polycarbonate.
   3. Photo Sensor: Cadmium sulfide.
   4. Provide external sliding shield for field adjustment of light level activation.
   5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
   6. Voltage: As required to control the load indicated on the drawings.
   7. Failure Mode: Fails to the on position.
   8. Load Rating: As required to control the load indicated on the drawings.

B. Locking Receptacle-Mounted Outdoor Photo Controls
   1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.

2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.
8. Surge Protection: 160 joule metal oxide varistor.

C. Button Type Outdoor Photo Controls
1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.
2. Housing: Weather resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.

2.06 DAYLIGHTING CONTROLS

A. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

B. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
1. Sensor Type: Filtered silicon photo diode.
2. Sensor Range:
3. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
4. Wireless Daylighting Control Photo Sensors:
a. RF Range: 30 feet through typical construction materials.
b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
c. Power: Battery-operated with minimum ten-year battery life.

C. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.

D. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
3. Control Capability:
a. Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.

E. Daylighting Control Switching Modules for Wireless Sensors:

1. Description: Plenum rated, self-contained relay compatible with specified wireless photo sensors for switching of line voltage loads in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
3. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
4. Control Capability: Capable of controlling one programmable channel.
5. Input Supply Voltage: Dual rated for 120/277 V ac.
6. Load Rating: As required to control the load indicated on drawings.

F. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.

G. Daylighting Control Dimming Modules for Wireless Sensors:
1. Description: Plenum rated control unit compatible with specified wireless photo sensors and with specified dimming ballasts, for continuous dimming of compatible dimming ballasts in response to changes in measured light levels according to selected settings.
2. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
3. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
4. Control Capability: Capable of controlling up to 32 ballasts with up to two separately programmable daylighting zones.

H. Power Packs for Low Voltage Daylighting Control Modules:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
2. Input Supply Voltage: Dual rated for 120/277 V ac.

2.07 LIGHTING CONTACTORS

A. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.

B. Short Circuit Current Rating:
1. Provide contactors with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

C. Enclosures:
1. Comply with NEMA ICS 6.
2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

3. Finish: Manufacturer's standard unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.

G. Provide required supports in accordance with Section 260529.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Occupancy Sensor Locations:
   1. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

J. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.
   2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.

K. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

L. Daylighting Control Photo Sensor Locations:
   1. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the

measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.

2. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

M. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test time switches to verify proper operation.

E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.04 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.

D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.

G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.05 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Section 017900 - Demonstration and Training, for additional requirements.

B. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.

C. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

END OF SECTION

SECTION 262100
LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260529 - Hangers and Supports for Electrical Systems.

E. Section 260533.13 - Conduit for Electrical Systems.

F. Section 260533.23 - Surface Raceways for Electrical Systems: Wireways.

G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

H. Section 262300 - Low-Voltage Switchgear: Service entrance equipment.
   1. Includes utility metering transformer compartment.
   2. Includes non-utility electrical metering.

I. Section 262413 - Switchboards: Service entrance equipment.
   1. Includes utility metering transformer compartment.
   2. Includes non-utility electrical metering.

J. Section 262416 - Panelboards: Service entrance equipment.

K. Section 262816.16 - Enclosed Switches: Service entrance equipment.

L. Section 263100 - Photovoltaic Collectors: Photovoltaic system for interconnection with normal utility electrical supply.

M. Section 263213 - Engine Generators: Emergency/standby power systems for interconnection with normal utility electrical supply.

N. Section 263600 - Transfer Switches: Service entrance equipment.

O. Section 264300 - Surge Protective Devices: Service entrance surge protective devices.

P. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.

Q. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.04 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2017.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.05 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:
   1. Verify the following with Utility Company representative:
      a. Utility Company requirements, including division of responsibility.
      b. Exact location and details of utility point of connection.
      c. Utility easement requirements.
      d. Utility Company charges associated with providing service.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
   3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:
   1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
   2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

C. Project Record Documents: Record actual locations of equipment and installed service routing.

1.07 QUALITY ASSURANCE

A. Comply with the following:
   1. IEEE C2 (National Electrical Safety Code).
   2. NFPA 70 (National Electrical Code).
   3. The requirements of the Utility Company.
   4. The requirements of the local authorities having jurisdiction.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility

Company point of supply and service entrance equipment.

B. Electrical Service Characteristics: As indicated on drawings.

C. Utility Company: As indicated on drawings.

D. Division of Responsibility: As indicated on drawings.

E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required trenching and backfilling in accordance with Section 312316.13.

E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 033000.

F. Provide required protective bollards in accordance with Utility Company requirements.

G. Provide required support and attachment components in accordance with Section 260529.

H. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.

I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

3.04 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 262200
LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General purpose transformers.

B. K-factor transformers rated for nonlinear loads.

C. Buck-boost transformers.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260533.13 - Conduit for Electrical Systems: Flexible conduit connections.

E. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 260916 - Electric Controls and Relays: Industrial control transformers.

H. Section 262416 - Panelboards.

I. Section 262713 - Electricity Metering: Instrument transformers for electrical metering.

1.03 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.

C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.

F. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.

J. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
   4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
   1. Altitude: Less than 3,300 feet.
   2. Ambient Temperature:
      a. Greater than 10 kVA: Not exceeding 104 degrees F.
      b. Less than 10 kVA: Not exceeding 77 degrees F.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 GENERAL PURPOSE TRANSFORMERS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

B. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
   2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

C. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.

D. Winding Taps:
   1. Less than 3 kVA: None.
   2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
   3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
   4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

F. Sound Levels: Standard sound levels complying with NEMA ST 20

G. Mounting Provisions:
   1. Less than 15 kVA: Suitable for wall mounting.
   2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
   3. Larger than 75 kVA: Suitable for floor mounting.

H. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Construction: Steel.
      a. Less than 15 kVA: Totally enclosed, non-ventilated.
      b. 15 kVA and Larger: Ventilated.
   3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
   4. Provide lifting eyes or brackets.

2.04 K-FACTOR TRANSFORMERS RATED FOR NONLINEAR LOADS

A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 1561, and designed to supply nonlinear loads to the degree designated by the UL defined K-factor; ratings as indicated on the drawings.

B. K-factor Rating: K-4, or higher.

C. Insulation System and Allowable Average Winding Temperature Rise: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.

D. Coil Conductors: Continuous aluminum windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.

E. Winding Taps: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.

F. Neutral Bus: Sized to accommodate twice the rated secondary current.

G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

H. Sound Levels: Standard sound levels complying with NEMA ST 20

I. Mounting Provisions:
   1. Up to 75 kVA: Suitable for wall, floor, or trapeze mounting.

2. Larger than 75 kVA: Suitable for floor mounting.

J. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Construction: Steel, ventilated.
   3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
   4. Provide lifting eyes or brackets.

2.05 BUCK-BOOST TRANSFORMERS

A. Description: Self-cooled, four winding, buck-boost transformers listed and labeled as complying with UL 506 or UL 1561, and suitable for field connection as an autotransformer; ratings as indicated on the drawings.

B. Insulation System and Allowable Average Winding Temperature Rise:
   1. Less than 0.25 kVA: Class 105 degree C insulation system with 55 degrees C rise.
   2. 0.25 kVA and Larger: Class 180 degree C insulation system with 115 degree C rise.

C. Coil Conductors: Continuous windings.

D. Lugs: Suitable for terminating conductors sized for full rated load ampacity of transformer when operating in buck-boost configuration indicated.

E. Mounting Provisions: Suitable for wall mounting.

F. Transformer Enclosure: Comply with NEMA ST 20.
   1. Environment Type per NEMA 250: Type 3R.
   2. Construction: Steel, totally enclosed, non-ventilated.
   3. Finish: Manufacturer's standard grey, suitable for outdoor installations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 260533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Install transformers plumb and level.

G. Transformer Support:
   1. Provide required support and attachment in accordance with Section 260529, where not furnished by transformer manufacturer.
   2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.

3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Provide grounding and bonding in accordance with Section 260526.

I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.03 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 262300
LOW-VOLTAGE SWITCHGEAR

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) standard (non-arc-resistant) metal-enclosed drawout switchgear and accessories for service and distribution applications.

B. Low-voltage power circuit breakers for switchgear.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 262100 - Low-Voltage Electrical Service Entrance.

G. Section 262413 - Switchboards.

H. Section 262813 - Fuses: Fuses for fusible switches.
   1. Includes requirements for spare fuses and spare fuse cabinets.

I. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. ANSI C37.50 - American National Standard for Switchgear - Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures; 2012.

B. ANSI C37.51 - American National Standard for Switchgear - Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies - Conformance Test Procedures; 2003 (R2010), with Amendment 1, 2010.

C. IEEE C37.13 - IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures; 2015.

D. IEEE C37.16 - IEEE Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC (3200 V and below) Power Circuit Breakers; 2009.

E. IEEE C37.17 - IEEE Standard for Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers; 2012.

F. IEEE C37.20.1 - IEEE Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear; 2015.

G. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

M. UL 1066 - Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures; Current Edition, Including All Revisions.

N. UL 1558 - Switchgear; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
   5. Notify Architect of any conflicts with or deviations Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchgear:
   1. Coordinate with Utility Company to provide switchgear with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
   3. Obtain Utility Company approval of switchgear prior to fabrication.
   4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchgear, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, short-time current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
   1. Include dimensioned plan and elevation views of switchgear and adjacent equipment with all required clearances indicated.
   2. Include wiring diagrams showing all factory and field connections.
   3. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Service Entrance Switchgear: Include documentation of Utility Company approval of switchgear.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.
   2. Enclosure Keys: Two of each different key.
   3. Circuit Breakers:
      a. Handles Necessary for Racking of Devices: One for each electrical room containing drawout switchgear.

b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout switchgear.
c. Removable Covers: One for blocking each different opening size when circuit breaker is temporarily removed from its compartment.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchgear in accordance with manufacturer's instructions and IEEE C37.20.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchgear, which is not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchgear internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Low-Voltage Switchgear - Other Acceptable Manufacturers
1. BB/GE: www.geindustrial.com/#sle.
2. Eaton Corporation: www.eaton.com/#sle.
3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
4. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 LOW-VOLTAGE SWITCHGEAR

A. Provide switchgear assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front standard (non-arc-resistant) type metal-enclosed drawout switchgear complying with IEEE C37.20.1 and ANSI C37.51; listed and labeled as complying with UL 1558; ratings, configurations and features as indicated on the drawings.

D. Service Entrance Switchgear:
1. Listed and labeled as suitable for use as service equipment according to UL 869A.
2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
3. Comply with Utility Company requirements for electrical service.

E. Seismic Qualification: Provide switchgear and associated components suitable for application under the seismic design criteria specified in Section 260548 where required. Include certification of compliance with submittals.

F. Service Conditions:
1. Provide switchgear and associated components suitable for operation under the following service conditions without derating:
a. Altitude: Less than 6,600 feet.
b. Ambient Temperature: Between -22 degrees F and 104 degrees F.
2. Provide switchgear and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

G. Short Circuit Current Rating:

1. Provide switchgear with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

H. Short-Time Current (30-Cycle Withstand) Rating: Equivalent to specified short circuit current rating.

I. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

J. Bussing: Sized in accordance with UL 1558 temperature rise requirements.
   1. Main bus (horizontal cross bus) to be fully rated through full length of switchgear.
   2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   3. Provide solidly bonded equipment ground bus through full length of switchgear, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   4. Phase and Neutral Bus Material: Aluminum or copper.
   5. Ground Bus Material: Aluminum or copper.

K. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.
   2. Load Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Lug Type:

L. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. Outdoor Locations: Type 3R.
   2. Finish: Manufacturer's standard unless otherwise indicated.
   3. Outdoor Enclosures:
      a. Color: Manufacturer's standard.
      b. Access Doors: Lockable, with all locks keyed alike.

M. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

N. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list switchgear as a complete assembly including surge protective device.

O. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

P. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 LOW-VOLTAGE POWER CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, trip-free low-voltage power circuit breakers with two-step stored energy closing mechanism; 100 percent rated; complying with IEEE C37.13, IEEE C37.16, IEEE C37.17, and ANSI C37.50; listed and labeled as complying with UL 1066;

ratings, configurations, and features as indicated on the drawings.

B. Interrupting Capacity: Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.

C. Construction: Drawout.
   1. Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
   2. Provide safety interlock to prevent racking of circuit breaker while in the ON position.

D. Trip Units: Solid state, microprocessor-based, true rms sensing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchgear in accordance with NECA 1 (general workmanship) and IEEE C37.20.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for drawout circuit breakers.

D. Provide required support and attachment in accordance with Section 260529.

E. Install switchgear plumb and level.

F. Unless otherwise indicated, mount switchgear on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.

G. Provide grounding and bonding in accordance with Section 260526.

H. Install all field-installed devices, components, and accessories.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Before energizing switchgear, perform preoperation checks in accordance with IEEE C37.20.1.

D. Inspect and test in accordance with NETA ATS, except Section 4.

E. Perform inspections and tests listed in NETA ATS, Section 7.1.

F. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

G. Correct deficiencies and replace damaged or defective switchgear assemblies or associated components.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchgear covers and doors.

3.04 CLEANING

A. Clean dirt and debris from switchgear enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

END OF SECTION

SECTION 262413
SWITCHBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

G. Section 262100 - Low-Voltage Electrical Service Entrance.

H. Section 262300 - Low-Voltage Switchgear.

I. Section 262419 - Motor-Control Centers.

J. Section 262813 - Fuses: Fuses for fusible switches.

K. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

G. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.

H. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less; 2013.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

L. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

M. UL 891 - Switchboards; Current Edition, Including All Revisions.

N. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
   4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:
   1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
   2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
   3. Obtain Utility Company approval of switchboard prior to fabrication.
   4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switchboards:
   1. ABB/GE: www.geindustrial.com/#sle.
   2. Eaton Corporation: www.eaton.com/#sle.
   3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   4. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 SWITCHBOARDS

A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

D. Service Entrance Switchboards:
   1. Listed and labeled as suitable for use as service equipment according to UL 869A.
   2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
   3. Comply with Utility Company requirements for electrical service.

E. Service Conditions:
   1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
      a. Altitude: Less than 6,600 feet.
      b. Ambient Temperature:
         1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.
         2) Switchboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
   2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

F. Short Circuit Current Rating:
   1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

H. Bussing: Sized in accordance with UL 891 temperature rise requirements.
   1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
   2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   3. Phase and Neutral Bus Material: Aluminum.
   4. Ground Bus Material: Aluminum.

I. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.
   2. Load Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Lug Type:

J. Enclosures:
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   2. Finish: Manufacturer's standard unless otherwise indicated.

K. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

L. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list switchboards as a complete assembly including surge protective device.

M. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

N. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

O. Instrument Transformers:
   1. Comply with IEEE C57.13.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Connect secondaries to shorting terminal blocks.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Devices:
   1. Fusible Switches:
      a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
      b. Fuse Clips: As required to accept indicated fuses.
      c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

B. Circuit Breakers:
   1. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   2. Molded Case Circuit Breakers:
      a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
      b. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
      c. Provide the following features and accessories where indicated or where required to complete installation:
         1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
   3. Insulated Case Circuit Breakers:
      a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
      b. Trip Units: Solid state, microprocessor-based, true rms sensing.

2.04 SOURCE QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
   1. Dielectric tests.
   2. Mechanical operation tests.
   3. Grounding of instrument transformer cases test.
   4. Electrical operation and control wiring tests, including polarity and sequence tests.
   5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.

E. Provide required support and attachment in accordance with Section 260529.

F. Install switchboards plumb and level.

G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.

H. Provide grounding and bonding in accordance with Section 260526.

I. Install all field-installed devices, components, and accessories.

J. Provide fuses complying with Section 262813 for fusible switches as indicated.

K. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

M. Provide filler plates to cover unused spaces in switchboards.

3.03 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchboard covers and doors.

3.04 CLEANING

A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

3.05 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution panelboards.

B. Lighting and appliance panelboards.

C. Load centers.

D. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
   1. Includes requirements for the seismic qualification of equipment specified in this section.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.

F. Section 262813 - Fuses: Fuses for fusible switches and spare fuse cabinets.

G. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

E. NEMA PB 1 - Panelboards; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

N. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation.

C. Short Circuit Current Rating:
1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

G. Conductor Terminations: Suitable for use with the conductors to be installed.

H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
2. Boxes: Galvanized steel unless otherwise indicated.
    a. Provide wiring gutters sized to accommodate the conductors to be installed.
3. Fronts:
    a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
    b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.

I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2.03 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
1. Phase and Neutral Bus Material: Aluminum.
2. Ground Bus Material: Aluminum.

D. Circuit Breakers:
1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.

E. Enclosures:
1. Provide surface-mounted enclosures unless otherwise indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum.
3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to

overcurrent protective device handles without exposing live parts.

3. Provide clear plastic circuit directory holder mounted on inside of door.

2.05 LOAD CENTERS

A. Description: Circuit breaker type load centers listed and labeled as complying with UL 67; ratings, configurations, and features as indicated on the drawings.

B. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Bus Material: Aluminum or copper.

C. Circuit Breakers: Thermal magnetic plug-in type.

D. Enclosures:
   1. Provide flush-mounted enclosures unless otherwise indicated.
   2. Provide circuit directory label on inside of door or individual circuit labels adjacent to circuit breakers.

2.06 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   6. Provide the following circuit breaker types where indicated:
      a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
      b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
      c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 260529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.

J. Provide grounding and bonding in accordance with Section 260526.

K. Install all field-installed branch devices, components, and accessories.

L. Provide filler plates to cover unused spaces in panelboards.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.

D. Test GFCI circuit breakers to verify proper operation.

E. Test AFCI circuit breakers to verify proper operation.

F. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 262419
MOTOR-CONTROL CENTERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Low-voltage (600 V and less) standard (non-arc-resistant) NEMA motor control centers.

B. Motor control center units:
   1. Combination magnetic motor starter units.

C. Overcurrent protective devices for motor control centers and associated units, including overload relays.

D. Motor control accessories:
   1. Auxiliary contacts.
   2. Pilot devices.
   3. Control power transformers.
   4. Control terminal blocks.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 262100 - Low-Voltage Electrical Service Entrance.

G. Section 262200 - Low-Voltage Transformers: For integration into equipment specified in this section, where indicated.

H. Section 262416 - Panelboards: For integration into equipment specified in this section, where indicated.

I. Section 262813 - Fuses: Fuses for fusible switches.

J. Section 264300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 402 - Standard for Installing and Maintaining Motor Control Centers; 2014.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

F. NEMA ICS 2.3 - Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers; 2019.

G. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.

H. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).

I. NEMA ICS 18 - Motor Control Centers; 2001 (Reaffirmed 2007).

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 845 - Motor Control Centers; Current Edition, Including All Revisions.

N. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor control centers, enclosures, units, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, unit arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Manufacturer's equipment seismic qualification certification.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store motor control centers in accordance with manufacturer's instructions, NECA 402, and NEMA ICS 2.3.

B. Store in a clean, dry space having a uniform temperature to prevent condensation. Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Motor Control Centers:
   1. ABB/GE: www.geindustrial.com/#sle.
   2. Eaton Corporation: www.eaton.com/#sle.
   3. Rockwell Automation, Inc.; Allen-Bradley Products: ab.rockwellautomation.com/#sle.
   4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
   5. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 MOTOR CONTROL CENTERS

A. Provide motor control centers consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front standard (non-arc-resistant) type motor control center assemblies complying with NEMA ICS 18, and listed and labeled as complying with UL 845; ratings, configurations and features as indicated on the drawings.

D. Configuration:
   1. Arrangement: Front- and rear-mounted units.

2. NEMA Classification and Wiring Type: NEMA ICS 18, Class I, Type B (B-T for units size 3 or smaller).

E. Service Conditions:
   1. Provide motor control centers and associated components suitable for operation under the following service conditions without derating:
      a. Altitude:
         1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
         2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide motor control centers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

F. Short Circuit Current Rating:
   1. Provide motor control centers and associated units with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

H. Bussing:
   1. Horizontal Main Bus: Size for a maximum temperature rise of 117 degrees F over an ambient temperature of 104 degrees F, in compliance with NEMA ICS 18 and UL 845 requirements.
   2. Vertical Bus: Minimum size of 300 A, in compliance with NEMA ICS 18 requirements.
   3. Provide solidly bonded equipment ground bus through full length of motor control center, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
   4. Phase and Neutral Bus Material: Copper.
   5. Ground Bus Material: Copper.

I. Conductor Terminations: Suitable for use with the conductors to be installed.
   1. Line Conductor Terminations:
      a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
      b. Main and Neutral Lug Type: Mechanical.

J. Enclosures:
   1. Comply with NEMA ICS 6.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   3. Finish: Manufacturer's standard unless otherwise indicated.

K. Future Provisions:
   1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

L. Owner Metering:
   1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
   2. Measured Parameters:
      a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
      b. Current (Amps): For each phase.
      c. Frequency (Hz).
      d. Real power (kW): For each phase, 3-phase total.

e. Reactive power (kVAR): For each phase, 3-phase total.
f. Apparent power (kVA): For each phase, 3-phase total.
g. Power factor.
3. Meter Accuracy: Plus/minus 1.0 percent.

M. Instrument Transformers:
1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.03 MOTOR CONTROL CENTER UNITS

A. Combination Magnetic Motor Starter Units:
1. Description: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
2. Configuration: Full-voltage non-reversing type unless otherwise indicated.
3. Disconnects: Circuit breaker type.
a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
4. Overload Relays: Bimetallic thermal type unless otherwise indicated.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
3. Trip-free operation.
4. Visible trip indication.
5. Resettable.
a. Employ manual reset unless otherwise indicated.
b. Do not employ automatic reset with two-wire control.
6. Bimetallic Thermal Overload Relays:
a. Interchangeable current elements/heaters.
b. Adjustable trip; plus/minus 10 percent of nominal, minimum.
c. Trip test function.

B. Circuit Breakers:
1. Interrupting Capacity (not applicable to motor circuit protectors):
a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Motor Circuit Protectors:
a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings,

configurations, and features as indicated on the drawings.

b. Provide field-adjustable magnetic instantaneous trip setting.

2.05 MOTOR CONTROL ACCESSORIES

A. Auxiliary Contacts:
   1. Comply with NEMA ICS 5.
   2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each starter unit, minimum.

B. Pilot Devices:
   1. Comply with NEMA ICS 5; heavy-duty type.
   2. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
   3. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
   4. Indicating Lights: Push-to-test type unless otherwise indicated.
   5. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:
   1. Comply with NEMA ICS 5.
   2. Provide number and type of relays indicated or required to perform necessary functions.

D. Control Power Transformers:
   1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus _____ VA spare capacity.
   2. Include primary and secondary fuses.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the motor control centers and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive motor control centers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install motor control centers in accordance with NECA 1 (general workmanship), NECA 402, and NEMA ICS 2.3.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Provide required support and attachment in accordance with Section 260529.

E. Install motor control centers plumb and level.

F. Unless otherwise indicated, mount motor control centers on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.

G. Provide grounding and bonding in accordance with Section 260526.

H. Install all field-installed devices, components, and accessories.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

K. Provide filler plates to cover unused spaces.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Before energizing motor control center, perform insulation resistance testing in accordance with NECA 402 and NEMA ICS 2.3.

C. Inspect and test in accordance with NETA ATS, except Section 4.

D. Perform inspections and tests listed in NETA ATS, Section 7.16.2.1.

E. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

F. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

G. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

H. Correct deficiencies and replace damaged or defective motor control centers or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of motor control center covers and doors.

3.05 CLEANING

A. Clean dirt and debris from motor control center enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

3.06 PROTECTION

A. Protect installed motor control centers from subsequent construction operations.

END OF SECTION

SECTION 262713
ELECTRICITY METERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Equipment for Owner electricity metering:

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260533.16 - Boxes for Electrical Systems: Cabinets and enclosures for metering system components.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262100 - Low-Voltage Electrical Service Entrance: Requirements for Utility Company electricity metering.

F. Section 262300 - Low-Voltage Switchgear: For interface with meters specified in this section.

G. Section 262413 - Switchboards: For interface with meters specified in this section.

H. Section 262416 - Panelboards: For interface with meters specified in this section.

I. Section 262813 - Fuses.

1.03 REFERENCE STANDARDS

A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2016.

B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

E. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.
2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electricity Meters:
   1. Veris Industries; E5x Series Enhanced Power and Energy Meter:
   2. Same as manufacturer of electrical distribution equipment used for this project.
      a. ABB/GE: www.geindustrial.com/#sle.
      b. Eaton Corporation: www.eaton.com/#sle.
      c. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
      d. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 EQUIPMENT FOR OWNER ELECTRICITY METERING

A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.

D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.

E. Enclosures:
   1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 260533.16.
   2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   3. Finish: Manufacturer's standard unless otherwise indicated.

F. Instrument Transformers:
   1. Comply with IEEE C57.13, where applicable.
   2. Select suitable ratio, burden, and accuracy as required for connected devices.
   3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
   4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive meters.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Provide required support and attachment components in accordance with Section 260529.

D. Provide grounding and bonding in accordance with Section 260526.

E. Provide fuses complying with Section 262813 as required.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

E. Correct deficiencies and replace damaged or defective metering system components.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

A. Protect installed system components from subsequent construction operations.

END OF SECTION

SECTION 262726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Fan speed controllers.

D. Receptacles.

E. Wall plates.

F. Floor box service fittings.

G. Poke-through assemblies.

H. Access floor boxes.

1.02 RELATED REQUIREMENTS

A. Section 096900 - Access Flooring.

B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

C. Section 260526 - Grounding and Bonding for Electrical Systems.

D. Section 260533.16 - Boxes for Electrical Systems.

E. Section 260533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.

F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

G. Section 260583 - Wiring Connections: Cords and plugs for equipment.

H. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

I. Section 262723 - Indoor Service Poles.

1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g, with Amendment.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

M. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

N. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

O. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   4. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
   5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D. Provide tamper resistant receptacles for receptacles installed in dwelling units.

E. Provide GFCI protection for receptacles installed within 6 feet of sinks.

F. Provide GFCI protection for receptacles installed in kitchens.

G. Provide GFCI protection for receptacles serving electric drinking fountains.

H. Unless noted otherwise, do not use combination switch/receptacle devices.

I. For flush floor service fittings, use tile rings for installations in tile floors.

J. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.02 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Isolated Ground Convenience Receptacles: Orange.

C. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

2.03 WALL SWITCHES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.

2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.04 WALL DIMMERS

A. Manufacturers:
1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

C. Control: Slide control type with separate on/off switch.

2.05 FAN SPEED CONTROLLERS

A. Manufacturers:
1. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Description: 120 V AC, solid-state, full-range variable speed, slide control type with separate on/off switch, with integral radio frequency interference filtering, fan noise elimination circuitry, power failure preset memory, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1917.
1. Current Rating: 1.5 A unless otherwise indicated or required to control the load indicated on the drawings.

2.06 RECEPTACLES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

2. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
3. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
4. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
2. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
3. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.

E. USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.

2.07 WALL PLATES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

E. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.08 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Thomas & Betts Corporation: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Description: Service fittings compatible with floor boxes provided under Section 260533.16 with components, adapters, and trims required for complete installation.

2.09 POKE-THROUGH ASSEMBLIES

A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
2. Thomas & Betts Corporation: www.tnb.com/#sle.

3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

2.10 ACCESS FLOOR BOXES

A. Manufacturers - Access Floor Boxes:
1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
2. Thomas & Betts Corporation: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Description: Metallic multi-service box suitable for mounting in access floor system.

C. Configuration:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.04 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 262733
POWER DISTRIBUTION UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Power distribution units (PDUs).

1.02 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS

A. NEMA PB 1 - Panelboards; 2011.

B. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate cable lengths and construction, circuit arrangements and directory, control system wiring diagram, connection diagram for external wiring, and details of conduit and wiring connections and terminations.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect products from moisture and dust by storing them in a clean, dry location remote from areas involved in construction operations. Provide additional protection in accordance with manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not install until building finishes are complete.

B. Maintain temperature between 32 degrees F and 104 degrees F during and after installation of units.

C. Maintain relative humidity between 0 percent and 95 percent (noncondensing) during and after installation of units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Controlled Power Company: www.controlledpwr.com/#sle.

B. Liebert, a brand of Vertiv Co: www.vertivco.com/#sle.

C. Schneider Electric; APC Products: www.schneider-electric.us/#sle.

2.02 POWER DISTRIBUTION UNITS

A. Power Distribution Unit: For data processing equipment, suitable for underfloor cable connection, providing surge protection, harmonic filters, isolation transformer, voltage regulation, and branch circuit overcurrent protective devices.

B. Service Conditions:
   1. Temperature: 32 degrees F and 104 degrees F.
   2. Humidity: Less than 95 percent humidity (non-condensing).
   3. Altitude: Less than 10,000' above sea level.

C. Ratings:

1. System Continuous Rating: As indicated on Drawings.

D. Isolation Transformer: NEMA ST 20, factory-assembled, air cooled dry type shielded isolation transformer, ratings to match unit ratings specified.

E. Branch Circuit Panelboard: NEMA PB 1, circuit breaker type, with bus ratings to match unit capacity specified. Provide copper ground bus and double capacity neutral bus.

F. Molded Case Circuit Breakers: Plug-in type thermal magnetic trip circuit breakers, with common trip handle for all poles; UL listed.

2.03 CONTROLS AND INDICATORS

A. Controls: AC input circuit breaker; INDICATOR TEST switch.

B. Indicators: Provide audible and visual alarm indication of abnormal conditions.
1. Output Overvoltage: Higher than 6 percent above rated.
2. Output Undervoltage: Less than 13 percent below rated.

C. Meters: Use 1 percent accuracy meters.
1. Voltage: Input and output, phase-phase and phase-neutral.

2.04 ACCESSORIES

A. Power Supply Junction Box: Watertight box, with terminal blocks for connection of incoming power feeder circuit, and connector for input cable.

B. Control Circuit Junction Box: Watertight box, with terminal blocks for connection of control and interlock circuits, and connector for cable to unit.

2.05 SOURCE QUALITY CONTROL

A. Provide inspection and testing for completed power distribution units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide required support and attachment in accordance with Section 260529.

3.03 ADJUSTING

A. Adjust settings in accordance with manufacturer's instructions.

3.04 MAINTENANCE

A. Provide service and maintenance of power distribution units for one year from Date of Substantial Completion.

END OF SECTION

SECTION 262813
FUSES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fuses.

1.02 RELATED REQUIREMENTS

A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 262413 - Switchboards: Fusible switches.

C. Section 262416 - Panelboards: Fusible switches.

D. Section 262816.16 - Enclosed Switches: Fusible switches.

E. Section 263100 - Photovoltaic Collectors: Additional requirements for photovoltaic fuses.

1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.

E. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

G. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
   2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.

B. Littelfuse, Inc: www.littelfuse.com/#sle.

C. Mersen: ep-us.mersen.com/#sle.

2.02 APPLICATIONS

A. Service Entrance:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
   2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
   2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C. General Purpose Branch Circuits: Class RK1, time-delay.

D. Individual Motor Branch Circuits: Class RK1, time-delay.

2.03 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.
   1. Class RK1, Fast-Acting, Non-Time-Delay Fuses:
   2. Class RK5, Time-Delay Fuses:
   3. Class RK5, Fast-Acting, Non-Time-Delay Fuses:

H. Class J Fuses: Comply with UL 248-8.
   1. Class J, Fast-Acting, Non-Time-Delay Fuses:

I. Class L Fuses: Comply with UL 248-10.

J. Class T Fuses: Comply with UL 248-15.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 262816.13
ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 ENCLOSED CIRCUIT BREAKERS

A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between 23 degrees F and 104 degrees F.

D. Short Circuit Current Rating:
   1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.

E. Conductor Terminations: Suitable for use with the conductors to be installed.

F. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.

G. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

H. Provide externally operable handle with means for locking in the OFF position.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

B. Interrupting Capacity:
   1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
   2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

C. Conductor Terminations:
   1. Provide mechanical lugs unless otherwise indicated.
   2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

D. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 260529.

E. Install enclosed circuit breakers plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 260526.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than 800 amperes. Tests listed as optional are not required.

D. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 262816.16
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Enclosed safety switches.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 262813 - Fuses.

E. Section 263600 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com/#sle.

C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.

D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

2.02 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet.
   2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:
   1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

L. Heavy Duty Switches:
   1. Comply with NEMA KS 1.
   2. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 260529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 260526.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 263213
ENGINE GENERATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged engine generator system and associated components and accessories:
   1. Engine and engine accessory equipment.
   2. Alternator (generator).
   3. Generator set control system.
   4. Generator set enclosure.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 231113 - Facility Fuel-Oil Piping:
   1. Diesel fuel piping.
   2. Installation of diesel fuel system day tank specified in this section.

C. Section 235100 - Breechings, Chimneys, and Stacks: Engine exhaust piping.
   1. Includes installation of exhaust silencer specified in this section.

D. Section 260526 - Grounding and Bonding for Electrical Systems.

E. Section 260529 - Hangers and Supports for Electrical Systems.

F. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

H. Section 263600 - Transfer Switches.

1.03 REFERENCE STANDARDS

A. ASTM D975 - Standard Specification for Diesel Fuel; 2023a.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.

D. NEMA MG 1 - Motors and Generators; 2018.

E. NFPA 30 - Flammable and Combustible Liquids Code; 2018.

F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2018.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 99 - Health Care Facilities Code; 2018.

I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2019.

J. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.

K. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.

L. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.

2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
1. Include generator set sound level test data.

C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
1. Identify mounting conditions required for equipment seismic qualification.

D. Manufacturer's equipment seismic qualification certification.

E. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.

F. Specimen Warranty: Submit sample of manufacturer's warranty.

G. Evidence of qualifications for installer.

H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

I. Manufacturer's factory emissions certification.

J. Manufacturer's certification that products meet or exceed specified requirements.

K. Maintenance contracts.

L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Fuses: One of each type and size.
3. Extra Filter Elements: One of each type, including fuel, oil and air.

1.06 QUALITY ASSURANCE

A. Comply with the following:
1. NFPA 70 (National Electrical Code).
2. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
3. NFPA 30 (Flammable and Combustible Liquids Code).

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Packaged Engine Generator Set - Other Acceptable Manufacturers:
   1. Caterpillar Inc: www.cat.com/#sle.
   2. Cummins Power Generation Inc: www.cumminspower.com/#sle.
   3. Generac Power Systems: www.generac.com/industrial/#sle.Generac Power Systems: www.generac.com/industrial/#sle.Generac Power Systems: www.generac.com/industrial/#sle.
   4. Kohler Co: www.kohlerpower.com/#sle.
   5. MTU Onsite Energy, a Brand of Rolls-Royce Power Systems: www.mtuonsiteenergy.com/#sle.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:
   1. Application: Emergency/standby.
   2. Configuration: Single packaged engine generator set operated independently (not in parallel).

D. Packaged Engine Generator Set:
   1. Type: Diesel (compression ignition).
   2. Power Rating: _____ kW, standby.
   3. Voltage: As indicated on drawings.

E. Generator Set General Requirements:
   1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
   2. Factory-assembled, with components mounted on suitable base.
   3. List and label engine generator assembly as complying with UL 2200.
   4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
   5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.

F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

G. Starting and Load Acceptance Requirements:

1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
4. Maximum Load Step: Supports 100 percent of rated load in one step.

H. Exhaust Emissions Requirements:
1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

B. Engine Fuel System - Diesel (Compression Ignition):
1. Fuel Source: Diesel, ASTM D975 No. 2-D or approved cold weather diesel blends.
2. Fuel Storage: Sub-base fuel tank.
3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
5. Sub-Base Fuel Tank:
   a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.
   b. Tank Capacity: Size for minimum of 24 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
   c. Features:
      1) Direct reading fuel level gauge.
      2) Normal atmospheric vent.
      3) Emergency pressure relief vent.
      4) Fuel fill opening with lockable cap.
      5) Dedicated electrical conduit stub-up area.

C. Engine Starting System:
1. System Type: Electric, with DC solenoid-activated starting motor(s).
2. Battery(s):
   a. Battery Type: Lead-acid.
   b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
   c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.

4. Battery Charger:
    a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
    b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
    c. Recognized as complying with UL 1236.
    d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
    e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
    f. Provide alarm output contacts as necessary for alarm indications.

D. Engine Speed Control System (Governor):
    1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
    2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E. Engine Lubrication System:
    1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.

F. Engine Cooling System:
    1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
    2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
    3. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

G. Engine Air Intake and Exhaust System:
    1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
    2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
    3. Exhaust Silencer: Provide critical grade or better exhaust silencer with sound attenuation not less than basis of design; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.04 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:
    1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
    2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
    3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.

C. Temperature Rise: Comply with UL 2200.

D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.

E. Enclosure: NEMA MG 1, drip-proof.

F. Total Harmonic Distortion: Not greater than five percent.

2.05 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

B. Control Panel:
   1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
   2. Generator Set Control Functions:
      a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
      b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
      c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
      d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
      e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
      f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
      g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
   3. Generator Set Status Indications:
      a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
      b. Current (Amps): For each phase.
      c. Frequency (Hz).
      d. Real power (W/kW).
      e. Reactive power (VAR/kVAR).
      f. Apparent power (VA/kVA).
      g. Power factor.
      h. Duty Level: Actual load as percentage of rated power.
      i. Engine speed (RPM).
      j. Battery voltage (Volts DC).
      k. Engine oil pressure.
      l. Engine coolant temperature.
      m. Engine run time.
      n. Generator powering load (position signal from transfer switch).
   4. Generator Set Protection and Warning/Shutdown Indications:
      a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
         1) Overcrank (shutdown).
         2) Low coolant temperature (warning).
         3) High coolant temperature (warning).
         4) High coolant temperature (shutdown).
         5) Low oil pressure (shutdown).
         6) Overspeed (shutdown).
         7) Low fuel level (warning).
         8) Low coolant level (warning/shutdown).
         9) Generator control not in automatic mode (warning).
         10) High battery voltage (warning).
         11) Low cranking voltage (warning).
         12) Low battery voltage (warning).
         13) Battery charger failure (warning).

b. In addition to NFPA 110 requirements, provide the following protections/indications:
1) High AC voltage (shutdown).
2) Low AC voltage (shutdown).
3) High frequency (shutdown).
4) Low frequency (shutdown).
5) Overcurrent (shutdown).
c. Provide contacts for local and remote common alarm.
d. Provide lamp test function that illuminates all indicator lamps.
5. Other Control Panel Features:
a. Event log.

C. Remote Annunciator:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
2. Generator Set Status Indications:
a. Generator powering load (via position signal from transfer switch).
b. Communication functional.
3. Generator Set Warning/Shutdown Indications:
a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:
1) Overcrank (shutdown).
2) Low coolant temperature (warning).
3) High coolant temperature (warning).
4) High coolant temperature (shutdown).
5) Low oil pressure (shutdown).
6) Overspeed (shutdown).
7) Low fuel level (warning).
8) Low coolant level (warning/shutdown).
9) Generator control not in automatic mode (warning).
10) High battery voltage (warning).
11) Low cranking voltage (warning).
12) Low battery voltage (warning).
13) Battery charger failure (warning).
b. Provide audible alarm with silence function.
c. Provide lamp test function that illuminates all indicator lamps.

2.06 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.

B. Enclosure Material: Steel or aluminum.

C. Hardware Material: Stainless steel.

D. Color: Manufacturer's standard.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated

load under worst case ambient temperature.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.

D. Arrange equipment to provide minimum clearances and required maintenance access.

E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch high concrete pad constructed in accordance with Section 033000.

F. Provide required support and attachment in accordance with Section 260529.

G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H. Provide diesel fuel piping and venting in accordance with Section 231113, where not factory installed.

I. Provide engine exhaust piping in accordance with Section 235100, where not factory installed.
   1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
   2. Do not exceed manufacturer's maximum back pressure requirements.

J. Install exhaust silencer in accordance with Section 235100, where not factory installed.

K. Provide grounding and bonding in accordance with Section 260526.

L. Identify system wiring and components in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.

C. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

D. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

E. Preliminary inspection and testing to include, at a minimum:
   1. Inspect each system component for damage and defects.
   2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
   3. Check for proper oil and coolant levels.

F. Prepare and start system in accordance with manufacturer's instructions.

G. Provide field emissions testing where necessary for certification.

H. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

3.06 MAINTENANCE

A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

B. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION

SECTION 263353
STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Charger/rectifier units.

B. Inverter units.

C. Batteries.

1.02 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS

A. IEEE 519 - IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems; 2014.

B. NEMA PE 1 - Uninterruptible Power Systems (UPS) - Specification and Performance Verification; 2012 (Reaffirmed 2017).

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide catalog sheets and technical data sheets to indicate physical data and electrical performance, electrical characteristics, and connection requirements.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product. Include equipment installation outline, connection diagram for external cabling, internal wiring diagram, and written instruction for installation.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment from extreme temperature and humidity by storing in a conditioned space.

B. Protect equipment from dust and debris by wrapping unit in dusttight cover and storing away from construction activity.

1.07 FIELD CONDITIONS

A. Do not store or install unless temperature is maintained between 32 degrees F and 104 degrees F, at a relative humidity less than 95 percent (non-condensing).

1.08 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year warranty including coverage for batteries.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Uninterruptible Power Supply (UPS) System:

2.02 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS

A. System Configuration: Non-redundant type with reverse transfer. Designed for capacity expansion by addition of parallel modules in field with minimum downtime.

B. Components:

C. Design Standards: IEEE 519 and NEMA PE 1.

2.03 SYSTEM RATINGS AND OPERATING CHARACTERISTICS

A. System Continuous Rating: As indicated on drawings, over entire battery voltage range at specified power factor. Maintain output voltage within specified limits at any load from full load to no-load.

B. Battery Capacity: Capable of operating at full load for 3 hours.

C. Voltage Rating: 120/208 volts, 1 phase.

D. Input Voltage Operating Range: Plus or minus 10 percent.

E. Input Frequency Operating Range: 60 Hz. Plus or minus 3 Hz.

F. Input Current Limit: Adjustable to maximum of 125 percent of that required to operate at full load with battery bank on float charge.

G. UPS Power Factor Over Full Range of Loads and Input Voltages: 74 to 100 percent, lagging.

H. Harmonic Distortion of Input Current Wave Form: 5 percent maximum at full load.

I. Output Free Running Frequency: 60 Hz Plus or minus 0.5 percent.

J. Output Harmonic Distortion: Maximum 5 percent rms total harmonic distortion (THD) and maximum 3 percent any single harmonic, at rated frequency and voltage, from 10 percent load to full load and over battery voltage range, measured into a linear load.

K. Phase Displacement:
   1. 120 plus or minus 1 degrees for balanced loads.
   2. 120 plus or minus 4 degrees for 50 percent unbalanced loads.

L. Voltage Unbalance: 3 percent maximum line-line with 100 percent load unbalance.

2.04 DESIGN

A. Inverter Type: Pulse-width modulated.

B. Rectifier/Charger Capacity: Sufficient to supply full load to inverter while recharging fully-discharged battery to 95 percent of full capacity in four hours or less; and within the input current limits specified.

C. Forced Air Cooled Unit: Provide with redundant cooling so that failure of any one cabinet cooling fan or fan circuit will not affect continued operation at full load and ambient temperature of 77 degrees F or lower.

2.05 FABRICATION

A. Conversion Equipment Enclosure: NEMA 250, Type 1 enclosure allowing access from front for servicing adjustments and connections. Access through hinged door equipped with tumbler lock and latch handle. Equip cabinet for fork truck lifting.

2.06 BATTERY

A. Storage Battery: Lead calcium heavy duty industrial battery, designed for auxiliary power service. Provide battery with impact resistant plastic case. Provide cells with explosion proof vents, clear containers, and ample space for plate growth without stressing container and cover.

2.07 CONTROLS AND INDICATORS

A. Controls:
   1. AC input circuit breaker.
   2. Inverter operate switch to initiate inverter operation.
   3. Static switch transfer switch to permit manual actuation of static transfer switch.
   4. Static switch lock-out switch to inhibit automatic retransfer of load to inverter.
   5. Battery charge timer.
   6. Indicator test switch.
   7. Static switch preferred input circuit breaker
   8. Static switch output circuit breaker.
   9. Static switch bypass circuit breaker.
   10. Controls for maintenance bypass switch.

B. Indicators:
   1. Load connected to utility.
   2. Static transfer switch inhibited.
   3. High/low DC voltage.
   4. Overtemperature.
   5. Inverter output overload.

C. Meters: Use 1 percent accuracy meters to indicate the following:
   1. Rectifier/charger DC voltage and current.
   2. Utility, inverter output, and load AC voltage.
   3. Load AC current.
   4. Inverter output and utility frequency.
   5. UPS output watts.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide required support and attachment in accordance with Section 260529.

3.02 MAINTENANCE

A. Provide service and maintenance of uninterruptible power supply for one year from Date of Substantial Completion.

B. Include all costs, including labor, parts, and travel.

END OF SECTION

SECTION 263600
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
   1. Automatic transfer switches.
   2. Non-automatic transfer switches.
   3. Manual transfer switches.
   4. Includes service entrance rated transfer switches.
   5. Includes bypass/isolation transfer switches.
   6. Remote annunciators.

1.02 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 260526 - Grounding and Bonding for Electrical Systems.

C. Section 260529 - Hangers and Supports for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 262100 - Low-Voltage Electrical Service Entrance.

F. Section 262816.16 - Enclosed Switches: Safety switches not listed for use as transfer switch equipment.

G. Section 263213 - Engine Generators: For interface with transfer switches.
   1. Includes code requirements applicable to work of this section.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2020.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 99 - Health Care Facilities Code; 2018.

G. NFPA 110 - Standard for Emergency and Standby Power Systems; 2019.

H. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

I. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
   2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
   3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Coordinate the work with placement of supports, anchors, etc. required for mounting.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

D. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
   1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

E. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

F. Maintenance contracts.

G. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70 (National Electrical Code).
   2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for system Level specified in Section 263213.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Transfer Switches:
   1. Same as manufacturer of engine generator(s) used for this project.

2.02 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:

D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.

E. Automatic Transfer Switch:
   1. Transfer Switch Type: As indicated on the drawings.
   2. Transition Configuration: As indicated on the drawings.
   3. Voltage: As indicated on the drawings.
   4. Ampere Rating: As indicated on the drawings.
   5. Neutral Configuration: Solid neutral (unswitched), except as indicated.
   6. Load Served: As indicated on the drawings.
   7. Primary Source: As indicated on the drawings.
   8. Alternate Source: As indicated on the drawings.

F. Non-Automatic Transfer Switch:
   1. Transfer Switch Type: As indicated on the drawings.
   2. Transition Configuration: As indicated on the drawings.
   3. Voltage: As indicated on the drawings.
   4. Ampere Rating: As indicated on the drawings.
   5. Neutral Configuration: Solid neutral (unswitched), except as indicated.
   6. Load Served: As indicated on the drawings.
   7. Primary Source: As indicated on the drawings.
   8. Alternate Source: As indicated on the drawings.

G. Manual Transfer Switch:
   1. Voltage: As indicated on the drawings.
   2. Ampere Rating: As indicated on the drawings.
   3. Neutral Configuration: Solid neutral (unswitched), except as indicated.
   4. Load Served: As indicated on the drawings.
   5. Primary Source: As indicated on the drawings.
   6. Alternate Source: As indicated on the drawings.

H. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

I. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

J. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

K. Switching Methods:
   1. Open Transition:
      a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.

2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

L. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

M. Enclosures:
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
a. Indoor Clean, Dry Locations: Type 1 or Type 12.
b. Outdoor Locations: Type 3R or Type 4.
2. Provide lockable door(s) for outdoor locations.
3. Finish: Manufacturer's standard unless otherwise indicated.

N. Short Circuit Current Rating:
1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.

O. Automatic Transfer Switches:
1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
2. Control Functions:
a. Automatic mode.
b. Test Mode: Simulates failure of primary/normal source.
c. Voltage and Frequency Sensing:
1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
d. Outputs:
1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
2) Auxiliary contacts; one set(s) for each switch position.
e. Adjustable Time Delays:
1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
2) Transfer to alternate/emergency source time delay.
3) Retransfer to primary/normal source time delay.
4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.
g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
3. Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.
4. Automatic Sequence of Operations:

a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

P. Non-Automatic Transfer Switches:
1. Description: Transfer switches with manually initiated transfer between sources; electrically operated and mechanically held.
2. Control Functions:
a. Manual source selection.
b. Outputs:
1) Auxiliary contacts; one set for each switch position.
3. Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.

Q. Manual Transfer Switches:
1. Description: Transfer switches with manually initiated transfer between sources; mechanically operated and mechanically held.

R. Service Entrance Rated Transfer Switches:
1. Furnished with integral disconnecting and overcurrent protective device on the primary/normal source and with ground-fault protection where indicated.
2. Listed and labeled as suitable for use as service equipment according to UL 869A.

S. Remote Annunciators:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
2. Transfer Switch Status Indications:
a. Connected to alternate/emergency source.
b. Connected to primary/normal source.
c. Alternate/emergency source available.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 260529.

E. Install transfer switches plumb and level.

F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

G. Provide grounding and bonding in accordance with Section 260526.

H. Identify transfer switches and associated system wiring in accordance with Section 260553.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Automatic Transfer Switches:
   1. Inspect and test in accordance with NETA ATS, except Section 4.
   2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.

D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.04 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

3.06 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

3.07 MAINTENANCE

A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of transfer switches for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

END OF SECTION

SECTION 263633
CONNECTION CABINETS FOR PORTABLE GENERATORS AND LOAD BANKS - SCHNEIDER ELECTRIC ASCO 300

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.

1.02 ABBREVIATIONS AND ACRONYMS

A. QCP: Quick connect panel.

1.03 REFERENCE STANDARDS

A. ISO 9001 - Quality management systems -- Requirements; 2015.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

E. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

F. UL 508 - Industrial Control Equipment; Current Edition, Including All Revisions.

G. UL 891 - Switchboards; Current Edition, Including All Revisions.

H. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70.
   2. Requirements of authorities having jurisdiction.
   3. Applicable local codes.

B. Manufacturer Qualifications:
   1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 10 years.
   2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.
   3. Service, repair, and technical support services available 24 hours per day, 7 days per week, 365 days per year from manufacturer or their representative.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name,

and equipment tag number or service name as identified in Contract Documents.

D. Inspect products and report damage or violation of delivery, storage, and handling requirements to Engineer.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 24 months from date of shipment. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; ASCO 300 Series Quick Connect Power Panels; www.ascopower.com/#sle.

B. Source Limitations: Provide quick connect power panels and accessories produced by same manufacturer as other electrical distribution equipment for project and obtained from single supplier.

2.02 QUICK CONNECT POWER PANELS

A. Basis of Design: Schneider Electric; ASCO 300 Series; www.ascopower.com/#sle.

B. Description: Quick connect power panels with provisions for temporary facility connection to portable generators and/or load banks as indicated, in conjunction with transfer switch.

C. Listed and labeled as complying with UL 891 or UL 1008. Products listed only to UL 50 are not acceptable.

D. General Requirements:
   1. Withstand Current Ratings (WCR): Verified by testing supervised by nationally recognized testing laboratory (NRTL), not by calculation.
   2. Input/Output Temporary Camlock Connections:
      a. Camlock Connectors: Single-pole, camlock type, series 16.
      b. Input (Generator) Camlock Connections:
         1) Provide one row of recessed male camlock connectors for every 400 A of capacity or fraction thereof.
         2) For each row, provide five camlock connectors (one for each phase, one for neutral, and one for ground).
      c. Output (Load Bank) Camlock Connections:
         1) Provide one row of female camlock connectors with flip covers for every 400 A of capacity or fraction thereof.
         2) For each row, provide four camlock connectors (one for each phase and one for ground).
      d. Camlock Connector Color Code:
         1) 240 V and Below:
            (a) Phase 1: Black.
            (b) Phase 2: Red.
            (c) Phase 3 (Where Required): Blue.
         2) 440 V to 480 V:
            (a) Phase 1: Brown.
            (b) Phase 2: Orange.
            (c) Phase 3: Yellow.
         3) 600 V:
            (a) Phase 1: Black.

(b) Phase 2: Black.
(c) Phase 3: Black.
4) Neutral: White.
5) Ground: Green.

3. Ground: Minimum 25 percent rated.
4. Temporary Cable Provisions:
   a. Provide access holes for wiring chamber entry/exit specifically designed for conductors, with bushing or inherent design with no sharp edges that may come in contact with conductor insulation.
   b. Arrange connections so that cables drape downward when connected.
5. Enclosure:
   a. Construction: Aluminum or steel painted ANSI 61 gray or Type 316 stainless steel as indicated.
   b. Comply with UL 50 or UL 508.
   c. UL 50E Rating: Type 3R, maintained with temporary cables installed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions.

B. Install quick connect power panels in accordance with NECA 1.

C. Unless otherwise indicated, install and anchor floor-mounted and pad-mounted QCPs on raised concrete pad 4 inches high; see Section 033000.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Correct deficiencies and replace damaged or defective equipment or associated components.

3.03 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 264300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for service entrance locations.

B. Surge protective devices for distribution locations.

C. Surge protective devices for branch panelboard locations.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 262300 - Low-Voltage Switchgear.

C. Section 262413 - Switchboards.

D. Section 262416 - Panelboards.

E. Section 262419 - Motor-Control Centers.

1.03 ABBREVIATIONS AND ACRONYMS

A. SPD: Surge Protective Device.

1.04 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

1.07 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Field-installed, Externally Mounted Surge Protective Devices:
   1. ABB/GE: www.geindustrial.com/#sle.
   2. Current Technology; a brand of Thomas & Betts Power Solutions: www.tnbpowersolutions.com/#sle.
   3. Schneider Electric; Square D Brand Surgelogic Products: www.surgelogic.com/#sle.
   4. Surge Suppression, LLC (SSI): www.surgesuppression.com/#sle.

B. Factory-installed, Internally Mounted Surge Protective Devices:
   1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mouonted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:

E. UL 1449 Voltage Protection Ratings (VPRs):
   1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   2. 240/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   3. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
   4. 480V Delta System Voltage: Not more than 1,800 V for L-G mode and 3,000 V for L-L mode.

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Indoor clean, dry locations: Type 1.
   2. Outdoor locations: Type 3R.

H. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
   1. Switchgear: See Section 262300.
   2. Switchboards: See Section 262413.
   3. Panelboards: See Section 262416.
   4. Motor Control Centers: See Section 262419.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify system grounding and bonding is in accordance with Section 260526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

C. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 260526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 265100
INTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Ballasts and drivers.

E. Lamps.

1.02 RELATED REQUIREMENTS

A. Section 260529 - Hangers and Supports for Electrical Systems.

B. Section 260533.16 - Boxes for Electrical Systems.

C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.

D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 260918 - Remote Control Switching Devices: Remote controls for lighting, including network lighting controls, programmable relay panels, and remote control switching relays.

F. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.

G. Section 265561 - Theatrical Lighting: Stage lighting units and associated controls.

H. Section 265600 - Exterior Lighting.

1.03 REFERENCE STANDARDS

A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.

B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; 2015, with Errata (2017).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.

E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.

F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

J. UL 1598 - Luminaires; Current Edition, Including All Revisions.

K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.

2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for LED luminaires, including drivers.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

H. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
1. LED Tape - General Requirements:
a. Listed.
b. Designed for field cutting in accordance with listing.

2.03 EMERGENCY LIGHTING UNITS

A. Manufacturers:
1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
2. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
3. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.

B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

C. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

D. Battery:
1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

F. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.04 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
1. Number of Faces: Single- or double-face as indicated or as required for installed location.
2. Directional Arrows: As indicated or as required for installed location.

2.05 BALLASTS AND DRIVERS

A. Ballasts/Drivers - General Requirements:
1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

B. Dimmable LED Drivers:
1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
a. Wall Dimmers: See Section 262726.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

D. Provide required support and attachment in accordance with Section 260529.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Recessed Luminaires:
   1. Install trims tight to mounting surface with no visible light leakage.
   2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
   3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

G. Suspended Luminaires:
   1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
   2. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.

H. Install accessories furnished with each luminaire.

I. Bond products and metal accessories to branch circuit equipment grounding conductor.

J. Emergency Lighting Units:

K. Exit Signs:
   1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

L. Install lamps in each luminaire.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.04 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.05 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.06 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 265600
EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior luminaires.

B. Poles and accessories.

C. Luminaire accessories.

1.02 RELATED REQUIREMENTS

A. Section 260526 - Grounding and Bonding for Electrical Systems.

B. Section 260529 - Hangers and Supports for Electrical Systems.

C. Section 260533.16 - Boxes for Electrical Systems.

D. Section 262726 - Wiring Devices: Receptacles for installation in poles.

E. Section 262813 - Fuses.

F. Section 265100 - Interior Lighting.

1.03 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2017.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:

C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

PART 2 PRODUCTS

2.01 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

A. Manufacturers:
   1. Acuity Brands, Inc: www.acuitybrands.com/#sle.
   2. Alloy LED; www.alloyled.com/#sle.
   3. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com/#sle.
   4. Electro-Matic Visual, Inc; www.empvisual.com/#sle.
   5. Hubbell Lighting, Inc: www.hubbelllighting.com/#sle.
   6. Philips Lighting North America Corporation; www.lightingproducts.philips.com/#sle.

B. Provide products that comply with requirements of NFPA 70.

C. Provide products that are listed and labeled as complying with UL 1598, where applicable.

D. Provide products listed, classified, and labeled as suitable for the purpose intended.

E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

2.03 POLES

A. Manufacturers:
   1. Acuity Brands, Inc: www.acuitybrands.com/#sle.

B. All Poles:
   1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
   2. Material: Steel, unless otherwise indicated.
   3. Shape: Square straight, unless otherwise indicated.
   4. Finish: Match luminaire finish, unless otherwise indicated.
   5. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
   6. Unless otherwise indicated, provide with the following features/accessories:
      a. Handhole.
      b. Anchor bolts with leveling nuts or leveling shims.
      c. Anchor base cover.
      d. Provision for pole-mounted weatherproof GFI receptacle where indicated.

C. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.

B. Install products in accordance with manufacturer's instructions.

C. Install luminaires in accordance with NECA/IESNA 501.

D. Provide required support and attachment in accordance with Section 260529.

E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

F. Pole-Mounted Luminaires:
   1. Maintain the following minimum clearances:
      a. Comply with IEEE C2.
      b. Comply with utility company requirements.
   2. Foundation-Mounted Poles:
      a. Install foundations plumb.
      b. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
      c. Tighten anchor bolt nuts to manufacturer's recommended torque.
   3. Grounding:
      a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
   4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.

G. Install accessories furnished with each luminaire.

H. Bond products and metal accessories to branch circuit equipment grounding conductor.

I. Install lamps in each luminaire.

3.03 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.04 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.05 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 31 05 16
AGGREGATE MATERIALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coarse aggregate materials.
2. Fine aggregate materials.

B. Related Sections:

1. Section 31 11 20 – Soil Materials: Fill and grading materials.
2. American Public Works Association (APWA) Specifications (latest version).
3. Clifton Sanitation District Standards.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses.

B. ASTM International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 foot-pounds/foot^3 (2,700 kN-m/m^3))
3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
4. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers with proctor and gradation test data for each imported material.

C. Samples: Submit, in air-tight containers, 45-pound sample of each type of aggregate material used for fill to testing laboratory.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIAL TYPES

A. Type M1, Structural Fill:
Natural or crushed sandy gravel; free of clay, shale, organic matter. The portion of the material finer than a No. 40 sieve shall have a plasticity index less than six. Structural fill shall be densified to an in-place unit weight equal to at least 95 percent of the maximum laboratory density as determined by ASTM D1557.

Sieve Size	Percent Passing
3-inch	100
¾-inch	70
No. 200	5-20

Use for structural fill beneath foundations and shallow footings and as shown on the Drawings.

B. Type M2, Granular Backfill:
Imported granular backfill is required to establish final grade throughout the site. The portion of the material passing a No. 40 sieve shall have a plasticity index less than six. The fill shall be compacted to an in-place density equal to at least 92 percent of the maximum density as determined by ASTM D1557.

Sieve Size	Percent Passing
6-inch	100
No. 200	0 to 30

Use for imported granular backfill and as shown on the Drawings.

C. Type M3, Free Draining Floor Slab Base Course: Nonplastic, clean crushed angular rock:
A 6-inch thick free-draining gravel layer shall be placed immediately beneath floor slabs, and this material shall be underlain by a 6-inch layer of compacted structural fill. The free-draining material shall be densified using at least four passes of a smooth drum 5-ton vibratory roller or equivalent.

Sieve Size	Percent Passing
1-inch	100
No. 200	0 to 5

Use for free draining gravel under concrete floor slabs.

D. Type M4, Stabilization Cobble Rock: Angular to subangular cobble rock:

Size	Percent Passing
8-inch	100
3-inch	30
No. 200	0 to 5

Press cobble rock into the subgrade in 12-inch thick lifts where authorized by the Engineer to stabilize soft and unstable subgrade. Avoid otherwise disturbing the subgrade.

If the subgrade remains unstable after pressing in two 12-inch thick lifts, leave subgrade undisturbed for at least 24 hours and then review conditions with the Engineer.

Remove any excess rock that cannot be pressed into the subgrade to ensure nesting does not occur and voids are not left between cobbles.

2.2 UNTREATED BASE COURSE

A. Type M5, Aggregate Base Course (Road Base): Free of shale, clay, friable material and debris

Sieve Size	Percent Passing
1-½-inch	100
1-inch	90 to 100
¾-inch	70 to 85
½-inch	65 to 80
3/8-inch	55 to 75
No. 4	40 to 65
No. 16	25 to 40
No. 200	7 to 11

2.3 PIPE TRENCH BACKFILL MATERIALS

A. Type P1, Foundation Material:

Sieve Size	Percent Passing
2-inch	100
½-inch	0 to 5

B. Type P2, Bedding and Initial Backfill Material (Ductile Iron Pipe):

Sieve Size	Percent Passing
2-inch	100
No. 200	0 to 5

C. Type P3, Bedding and Initial Backfill Material (PVC or Polyethylene Pipe):

Sieve Size	Percent Passing
2-inch	100
No. 200	0 to 5

D. Type P4, Final Backfill Material:

Sieve Size	Percent Passing
3-inch	100
No. 200	0 to 15

2.4 SOURCE QUALITY CONTROL

A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with, ASTM D1557, ASTM D4318, ASTM C136.

B. Fine Aggregate Material - Testing and Analysis: Perform in accordance with, ASTM D1557, ASTM D4318, ASTM C136.

C. When tests indicate materials do not meet specified requirements, change material, moisture condition or dry as necessary and retest.

PART 3 EXECUTION

3.1 STOCKPILING

A. Stockpile materials on site at locations designated by Engineer.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.2 STOCKPILE CLEANUP

A. Remove unused stockpile materials.

B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

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SECTION 31 05 19
GEOTEXTILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geotextiles

1.2 RELATED SECTIONS

A. American Public Works Association (APWA) Specifications (latest version)

B. Clifton Sanitation District Standards

1.3 REFERENCES

A. ASTM D 5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

B. ASTM D 4355, Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).

C. ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

D. ASTM D 4533, Standard Test Method for Index Trapezoidal Tearing Strength of Geotextiles.

E. ASTM D 4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.

F. ASTM D 4873, Guide for Identification, Storage and Handling of Geotextiles.

G. ASTM D 4491, Standard Test Method for Water Permeability of Geotextiles by Permittivity.

H. ASTM D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

I. ASTM D 4354, Standard Practice for Sampling of Geosynthetics for Testing.

J. ASTM D 4759, Standard Practice for Determining the Specifications Conformance of Geosynthetics.

K. AASHTO M288-00, Geotextile Specification for Highway Applications.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00. Document compliance with these Specifications. Indicate products are suitable for application.

B. Product Data: Provide product physical and chemical properties. Prior to shipment, provide manufacturer's certification and quality control data to demonstrate the product meets or exceeds the specified requirements. Submit details and methods for anchoring the geotextile, making of field joints, joints in sumps, and liner penetrations

C. Manufacturer's instructions for storage, handling, installation and joining.

D. Material warranties.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 70 00.

B. Record actual locations of field seams, samples, repairs and tests.

1.7 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Deliver, label, store, protect and handle geotextile at site in accordance with manufacturer's guidelines and ASTM D 4873.

PART 2 PRODUCTS

2.1 GEOTEXTILE

A. Geotextiles shall be non-woven needle punched as specified herein.

B. Geotextile shall be manufactured from prime quality virgin polymer.

C. New, first quality product designed and manufactured specifically for the purpose of this work with the following properties:

Tested Property	Test Method	Frequency	Minimum Average Value
AASHTO M288 Class			>>1
Mass per Unit Area, oz/yd2	ASTM D 5261	90,000 ft^2	12
Grab Tensile Strength, lb	ASTM D 4632	90,000 ft^2	300
Grab Elongation, %	ASTM D 4632	90,000 ft^2	50
Puncture Strength, lb	ASTM D 4833	90,000 ft^2	140
Trapezoidal Tear Strength, lb (N)	ASTM D 4533	90,000 ft^2	115
Apparent Opening Size, Sieve No. (mm)	ASTM D 4751	540,000 ft^2	100
Permittivity, sec~'	ASTM D 4491	540,000 ft^2	0.80
Water Flow Rate, gpm/ft^2 (l/min/m^2)	ASTM D 4491	540,000 ft^2	60
UV Resistance (% retained after 500 hours)	ASTM D 4355	Per formulation	70
Roll Length[1], ft (m)			300
Roll Width[1], ft (m)			15
Roll Area, ft^2 (m^2)			4,500

NOTES:

- The property values listed are in the weaker principal direction. All values listed are minimum average roll values except UV resistance; it is a minimum value.
- [1]Roll widths and lengths have a tolerance of ±1%.

D. Manufacture geotextile in accordance with the Manufacturer's Quality Control Plan.

E. Prior to shipment, the geotextile shall be tested according to the test methods and frequencies included in this specification. Test results shall be accepted by the Engineer prior to delivery to the project site.

F. For storm drain infiltration system/sump manholes, utilize Mirafi 600X geotextile fabric or approved equivalent.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that surfaces upon which the geotextile is to be placed are graded smooth, free of all sharp rocks or other sharp objects, vegetation and stubble and acceptable to receive geotextile.

B. Verify that all concrete surfaces upon which the geotextile is to be placed is steel trowel finished smooth with rounded corners.

C. Inspect stored geotextile to verify that it has not been damaged in storage or handling.

3.2 DEPLOYMENT

A. Handle the geotextile in such a manner to ensure it is not damaged in any way.

B. Observe condition of geotextile during deployment. Note any damaged areas and bring to the attention of the Engineer. Damaged geotextile may be rejected by the Engineer or may be accepted with repairs in accordance with these specifications depending on the proposed location and extent of damage to the geotextile. Coordinate areas to be repaired with Engineer if accepted.

C. Install geotextile to the lines and grades as shown in the Drawings.

D. During placement of geotextile, do not entrap soil, stones or excessive moisture.

E. Do not expose geotextile to precipitation prior to being installed.

3.3 SEAMS

A. Geotextile shall be seamed using heat seaming or stitching method.

B. For heat seaming, fusion welding techniques shall be as recommended by the manufacturer.

C. Sewn seams shall be made using polymeric thread with chemical resistance equal to or greater than the geotextile.

D. All sewn seams shall be continuous.

E. In areas of proposed repairs, the patch shall be secured to the original geotextile with seams as described herein.

F. If more than 33% of the width of a roll requires patching, the patch shall extend the full width of the roll.

3.4 COVERING GEOTEXTILES

A. Geotextile shall not be exposed to direct sunlight for more than 15 days after installation.

B. The Contractor shall not use heavy equipment or allow traffic on the geotextile without providing protection as recommended by the manufacturer. Follow manufacturer's recommendations for spreading soil and aggregate material in the sumps and over the geotextile separating the rock fill and soil fill.

C. Geotextile shall be covered as soon as practical after installation. Notify Engineer when installation is complete prior to covering the geotextile. Installed geotextile shall not be left exposed for more than 15 days.

D. Geomembrane liner shall be carefully placed over the geotextile to avoid wrinkling or damage to the geotextile.

E. Aggregate or soil placed over the geotextile shall be placed using methods that protect the geotextile. Tracked equipment shall not be used for this work. Utilize rubber wheeled equipment and minimize turning movements as material is “walked” onto the geotextile. Comply with manufacturer’s recommendations.

END OF SECTION

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SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface debris removal.

B. Stripping construction site of plant life and grass including root systems to a minimum six inch depth.

C. Removal and disposal of shrubs, grasses, and trees.

D. Removing abandoned utilities.

1.2 RELATED SECTIONS

A. Section 01 50 00 – Temporary Facilities & Controls.

PART 2 PRODUCTS– NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Request underground utilities to be located and marked within and surrounding construction areas.

B. Verify that existing plant life designated to remain is tagged or identified.

3.2 PROTECTION

A. Locate, identify, and protect utilities that remain from damage.

B. Protect trees, plant growth, and features designated to remain, as final landscaping or outside of construction limits.

C. Retain and protect bench marks, survey monuments, and existing structures and utilities from damage or displacement.

D. Protect roads, fences, and other items to remain during construction.

E. Protect all adjoining property.

F. Protect existing drainage ditches unless otherwise noted.

G. Prevent air pollution or dust from becoming a nuisance to the public, to neighbors, and to others performing work on or near the project site. Comply with governing regulations.

3.3 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees, brush and shrubs within construction limits and in areas for which easements have been acquired. Remove stumps and roots completely.

C. Limit clearing and construction operation to areas required for construction and designated by the Engineer and within rights-of-way or easements obtained by the Owner.

3.4 REMOVAL

A. Remove debris and extracted plant life from site. Open burning and burial in trenches is prohibited.

B. Strip all heavy soils, heavy growths of grass, and sod that comprise the organic root-zone and dispose of offsite. The depth of stripping will generally be six (6) to twelve (12) inches.

C. Top soil stockpile shall be separated from other soil materials to prevent contamination.

D. Dispose all materials at locations that are in compliance with all Federal, State, and Local Regulations.

E. Grade areas in which groundwater is encountered to drain.

F. Remove abandoned utilities as required.

3.5 OBSTRUCTIONS

A. Remove and replace fences, fence post, signs and any structures encountered during construction to a condition equal to or better than it was prior to construction.

3.6 CLEANUP

A. Upon completion of the site work and project, clean the entire work area. Remove all excess excavated material, rocks, boulders, logs, trees, pipe, or debris of any type from the site and dispose at a site acceptable to Federal, State, and Local Regulations.

END OF SECTION

SECTION 31 11 20
SOIL MATERIALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Subsoil materials
2. Topsoil materials

B. Related Sections:

1. Section 31 05 16 – Aggregate Materials
2. American Public Works Association (APWA) Specifications (latest version)
3. Clifton Sanitation District Standards

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 foot-pound/foot^3 (2,700 kN-m/m^3)).
2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
3. ASTM D2922 – Test Methods for Density of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).
4. ASTM D3017 – Test Methods for Moisture Content of Soil and Soil Aggregate Mixtures in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials source. Provide materials from same source throughout the course of the project.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Furnish each material from single source throughout the Work.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

A. Subsoil Type S1: Excavated and reused material;

2.2 TOPSOIL MATERIALS

A. S3 (Topsoil): Select, graded, free of roots larger than ½ inch, subsoil, debris, large weeds and foreign matter.

1. Imported borrow.
2. Friable loam.
3. Reasonably free of roots, rocks larger than 1 inch, subsoil, debris, large weeds, and foreign matter.
4. Acidity range (pH) of 5.5 to 7.5
5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

2.3 SOURCE QUALITY CONTROL

A. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D1557.

B. When tests indicate materials do not meet specified requirements, change material and retest.

C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.

B. Stockpile excavated material meeting requirements for topsoil materials.

C. Remove excess excavated materials not intended for reuse, from site.

D. Remove excavated materials not meeting requirements for topsoil materials from site.

3.2 STOCKPILING

A. Stockpile materials on site.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Stockpile topsoil 8 feet high maximum.

E. Prevent intermixing of soil types or contamination.

F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

3.4 NATURAL GROUND SURFACE RESTORATION

A. Unimproved areas not otherwise classified as Bituminous Surface, Gravel Surface, Gravel Shoulder or Sod Surface.

B. Restore disturbed surfaces along trench in accordance with surface repair details of the project plans.

C. Grade disturbed area to match previously existing terrain.

END OF SECTION

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SECTION 31 22 13
ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating topsoil.
2. Excavating subsoil.
3. Cutting, grading, filling, rough contouring, and compacting for site structures.

B. Related Sections:

1. Section 31 05 16 – Aggregate Materials.
2. Section 31 10 00 – Site Clearing: Excavating topsoil.
3. Section 31 11 20 – Soil Materials.
4. Section 31 23 23 – Backfilling for Structures: General building area backfilling.
5. American Public Works Association (APWA) Specifications (latest version)
6. Clifton Sanitation District Standards

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 foot-pounds/foot^3 (600 kN-m/m^3)).
3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 foot-pounds/foot^3 (2,700 kN-m/m^3)).
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
7. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head).
8. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

9. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers. Provide materials from same source throughout the course of the project.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil: Type S3 as specified in Section 31 11 20.

B. Subsoil Fill: Type S1 as specified in Section 31 11 20.

C. Structural Fill: Type A1 as specified in Section 31 05 16.

D. Aggregate Base Course: Type A7 as specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Call Local Utility Line Information service not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum.

C. Notify utility company to remove and relocate utilities.

D. Protect utilities indicated to remain from damage.

E. Protect bench marks, survey control point, and existing structures from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

A. Stockpile excavated material in area designated on site in accordance with Section 31 11 20.

B. Benching Slopes: Horizontally bench existing slopes greater than 1: 4 to key placed fill material to slope to provide firm bearing.

C. Stability: Replace damaged or displaced subsoil as specified for fill.

3.4 FILLING

A. Place material in continuous layers as follows:

1. Subsoil Fill: Maximum eight inches compacted depth.
2. Structural Fill: Maximum eight inches compacted depth.
3. Aggregate Base Course: Maximum six inches compacted depth.

B. Maintain optimum moisture content of fill materials to attain required compaction density.

C. Slope grade away from structure minimum two inches in 10 feet unless noted otherwise.

D. Make grade changes gradual. Blend slope into level areas.

E. Repair or replace items indicated to remain damaged by excavation or filling.

3.5 TOLERANCES

A. Section 01 40 00 – Quality Assurance and Quality Control: Tolerances.

B. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Assurance and Quality Control: Testing and inspection services.

B. Perform laboratory material tests in accordance with ASTM D1557.

C. Perform in place compaction tests in accordance with the following:

1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
2. Moisture Tests: ASTM D3017.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.7 SCHEDULES

A. Structural Fill:

1. Compact uniformly to minimum 95 percent of maximum density.

B. Aggregate Base Course:

1. Compact uniformly to minimum 95 percent of maximum density.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals

B. References

C. Permits

D. Preparation

E. Structure Dewatering

F. Verification

G. Dewatering Discharge

H. Termination

I. Measurement and Payment

1.2 RELATED SECTIONS

A. Section 01 10 00 – Summary of Work

B. Section 01 20 00 – Measurement and Payment

C. Section 01 40 00 – Quality Assurance and Quality Control

D. Section 01 52 00 – Temporary Facilities and Controls

E. American Public Works Association (APWA) Specifications (latest version)

F. Clifton Sanitation District Standards

1.3 SUBMITTALS

A. Prior to the preconstruction conference the Contractor shall submit their dewatering plan to the Engineer and Owner to communicate the Contractors intent in regards to dewatering to achieve the required performance contained in these specifications. Submittal of a dewatering plan shall not be interpreted as an acceptance or approval by the Owner or Engineer of the Contractor's dewatering plan. The dewatering plan shall include at a minimum:

1. Major components of the dewatering system including size, location, spacing and details of wells, well points, vacuum piping, sumps, interception trenches, pumps, and other major dewatering features the Contractor anticipates utilizing.
2. Details of scheduling of dewatering activities relative to excavation and structure installation including backfilling and ceasing dewatering activities.
3. Contingency plans for equipment or power failure.
4. Procedures for verification that water levels have been lowered to the specified levels prior to trench excavation and pipe installation.
5. Location of dewatering disposal or discharge locations and the capacity to accept dewatering discharge. Provide a contingency plan for higher than anticipated flows when capacity of planned discharge and disposal locations may conceivably be exceeded.
6. Location and details of Best Management Practices (BMP's)
7. Agreements with entities accepting discharges
8. All permits obtained by the Contractor including any permit conditions and approvals for the discharge of water generated during the execution of the Work.
9. Other permits required for construction or operation of the dewatering system including the drilling of wells, temporary power drops, etc.
    a. The dewatering plan shall be designed and sealed by a qualified professional engineer registered in the State of Colorado. The Contractor will be responsible for selection and payment of the engineer to perform the dewatering system design.

1.4 REFERENCES

A. Colorado Department of Public Health and Environment Storm Water Program.

B. Geotechnical Investigation, Palisade Sewer Transfer, Clifton/Palisade, Colorado, Huddleston-Berry Engineering & Testing, LLC., August 2024

1.5 PERMITS

A. Submit a short-term activity exemption application and plan.

Contact Colorado Department of Public Health and Environment – General Permit for Construction Dewatering and/or Hydrostatic Testing for details.

B. Dewatering discharge to or across adjacent canals, drains, right-of-way, and private property outside of the designated limits of construction shall not be allowed unless the Contractor has obtained written approval from agency or property owner having

jurisdiction. Provide Agreements with dewatering plan submittal as described in Part 1.3 of this section.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Furnish, install and prepare for operation, all necessary machinery, appliances and equipment to maintain all structure excavations free from water during construction.

B. Contractor shall provide temporary power sources for all dewatering equipment that requires a power source.

C. Install or use existing well point for dewatering system before initial excavation commences to lower ground water levels. Well point piping to be left after construction for future use.

3.2 STRUCTURE DEWATERING

A. Dewater and dispose of water in such a manner that it does not cause injury to public or private property, or cause a nuisance or a menace to the general public.

B. Comply with Colorado Water Quality Standards, latest edition, for discharge of water to surface water.

C. The Contractor will be responsible for devising a system to achieve the required level of dewatering. It is anticipated that this system may incorporate wells, well points, interception trenches, sumps, etc. In addition, design and provide dewatering conveyance system to an approved disposal location. The Contractor shall submit details of this plan as described in Part 1.3 of this Section.

D. Draw and maintain static water level to at least two feet (2’) below the bottom of the excavation prior to excavating below the water table to maintain the undisturbed state of the foundation soils and allow placement of bedding material and backfill to the required density.

E. Remove all groundwater, seepage, stormwater and other water that accumulates in the excavation during construction. All structure excavations shall be kept free of water during construction or until otherwise requested by the Contractor and approved by the Engineer.

F. Prevent softening of the bottom of excavations and the formation of "quick" conditions or "boils" during excavation. The occurrence of such conditions will require over-excavation and subsequent backfilling to soils meeting City and APWA requirements at no additional cost to the Owner.

G. Additional cost for trench bottom stabilization resulting from inadequate dewatering and non-compliance with the performance specifications included herein, as determined by the Engineer, will be incidental to the work.

H. Compact native soil at the bottom of the excavation prior to placing bedding in accordance with City and APWA requirements.

I. Maintain static water level at least two feet (2') below the bottom of the excavation until the specified foundation and structure is placed in accordance with these specifications. Maintain water levels at least two feet (2') below the level of backfill during backfilling operations.

J. Control surface runoff (rainwater, snow melt, irrigation, etc.) to prevent entry or collection of water in excavations.

K. Install and operate a dewatering system so that adjacent structures or property are not endangered by the reduction in the groundwater level.

L. Monitor discharge from dewatering operations for changes in visual or odor components indicating the presence of contaminants including, but not limited to, gasoline and pesticides and other hazardous materials and toxins.

M. Cease dewatering operations and notify Engineer and regulatory agencies immediately upon observation of conditions that may indicate the presence of hazardous contaminants in the dewatering discharge or excavation.

3.3 VERIFICATION

A. Contractor's superintendent shall routinely observe conditions in excavations where dewatering is being performed on a daily basis to verify performance requirements are being met and that conditions in the excavation are in accordance with the Contract Documents.

B. Notify Engineer of any observations that may jeopardize the Work or is not in accordance with the Contract Documents.

C. Based on the verification performed by the Contractor and observations made by the Engineer in accordance with the General Conditions, the Engineer will determine if the performance requirements of the specifications as they relate to dewatering and construction of the improvements are generally being met. If the Engineer determines that the dewatering related Work is not being performed in accordance with the Contract Documents, the Contractor will be notified in accordance with the General Conditions and required to cease construction of the affected Work and revise and resubmit the described dewatering plan with appropriate adjustments to meet the requirements of the Contract Documents and implement any necessary changes to Contractor's dewatering approach and activities at no additional cost to the Owner.

3.4 DEWATERING DISCHARGE

A. Comply with all Local, State & Federal requirements, including (at a minimum):

1. Dewatering discharge water quality and quantity.

2. Dewatering discharge monitoring and sampling at the frequency stipulated in the permits, at any locations required therein.

3. Submit monitoring and sampling report to the appropriate agencies.

B. The Contractor shall be fully responsible for complying with State and Federal water quality requirements. Contractor shall design a dewatering discharge system to achieve such requirements. It is anticipated that stilling basins, geotextile dams, straw bails, silt fences, or siltation channels will be required to meet performance stipulations of the reference permits. Such temporary facilities may be constructed on-site, and will be required to be removed after completion of the Work. Captured sediment must be retained and disposed of at a site furnished by the Contractor. Discharging directly into adjacent surface waters without treatment shall not be permitted.

C. Contractor will not be allowed to utilize the constructed pipelines at or near the structure excavation to convey dewatering flows. Dewatering down the pipe is prohibited. Contractor shall provide temporary, dedicated dewatering pipe when necessary with Contractor's dewatering plan.

D. Work required to comply with water quality and permit requirements are considered incidental and additional payment will not be made for this Work.

3.5 TERMINATION

A. Allow groundwater to return to static level after excavations are backfilled as necessary to prevent floatation of constructed improvements.

B. Prevent disturbance of the compacted backfill and prevent flotation or movement of installed structure.

C. Remove or abandon all temporary improvements associated with the dewatering system in accordance with these specifications and any applicable state and federal rules and regulations.

D. Provide surface restoration as required to repair/replace any surface impacted by dewatering activities to a condition as good or better than preconstruction conditions at no additional cost to the Owner. Surface rehabilitation performed as a result of dewatering activities is considered incidental and no additional payment will be made.

E. At least one well point is to be installed near the lift station that will be protected, capped, and left in place for future use.

F. Comply with any dewatering termination requirements of any Local, State and Federal permits.

3.6 MEASUREMENT AND PAYMENT

A. Separate measurement and payment for the performance of dewatering as described in the Contract Documents will not be made. Performance of this work is considered incidental to other pay items and must be included therein.

END OF SECTION

SECTION 31 23 23
BACKFILLING FOR STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backfilling site structures to subgrade elevations.
2. Fill under slabs-on-grade.
3. Fill for over-excavation.

B. Related Sections:

1. Section 31 05 16 – Aggregate Materials
2. Section 31 11 20 – Soil Materials
3. Section 31 22 13 – Rough Grading: Site filling
4. Section 03 30 00 – Cast-in-Place Concrete: Concrete materials.
5. American Public Works Association (APWA) Specifications (latest version)
6. Clifton Sanitation District Standards

1.2 REFERENCES

A. ASTM International (ASTM):

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 foot-pounds/foot^3 (600 kN-m/m^3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 foot-pounds/foot^3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
7. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers. Provide materials from same source throughout the course of the project.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Structural Fill: Type M1 as specified in Section 31 05 16.

B. Stabilization Fill: Type M4 as specified in Section 31 05 16.

C. Aggregate Base Course: Type M5 as specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.

C. Scarify subgrade surface to depth of six inches.

D. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.3 BACKFILLING

A. Backfill areas to contours and elevations with unfrozen materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Place material in continuous layers as follows:

1. Structural Fill: Maximum eight inches compacted depth.
2. Aggregate Base Course: Maximum six inches compacted depth.

D. Employ placement method that does not disturb or damage other work.

E. Maintain optimum moisture content of backfill materials to attain required compaction density.

F. Slope grade away from building minimum two inches in 10 feet, unless noted otherwise.

G. Make gradual grade changes. Blend slope into level areas.

H. Remove surplus backfill materials from site.

I. Leave fill material stockpile areas free of excess fill materials.

3.4 TOLERANCES

A. Section 01 40 00 – Quality Assurance and Quality Control: Tolerances.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Assurance and Quality Control: Testing and inspection services.

B. Perform laboratory material tests in accordance with ASTM D1557.

C. Perform in place compaction tests in accordance with the following:

1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.

2. Moisture Tests: ASTM D3017.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

E. Proof roll compacted fill surfaces under slabs-on-grade.

3.6 PROTECTION OF FINISHED WORK

A. Section 01 50 00 –Temporary Facilities and Controls: Protection of existing and installed work.

B. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

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SECTION 33 05 60
PRECAST CONCRETE UTILITY STRUCTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Precast concrete vaults.

B. Miscellaneous precast concrete structures for utility use.

C. Bedding and cover materials.

D. Section Exclusions:
   1. Precast concrete manholes which shall be in accordance with Clifton Sanitation District Specifications and Standard Drawings.
   2. Precast concrete boxes and catch basins which shall be in accordance with Clifton Sanitation District Specifications and Standard Drawings.

1.2 REFERENCES

A. American Concrete Institute (ACI):

   1. ACI 318 - Building Code Requirements for Structural Concrete.
   2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures.
   3. ACI 530/530.1 - Building Code Requirements for Masonry Structures and Specifications for Masonry Structures.

B. ASTM International (ASTM):

   1. ASTM A48 - Standard Specification for Gray Iron Castings.
   2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. ASTM A536 - Standard Specification for Ductile Iron Castings.
   4. ASTM C33 - Standard Specification for Concrete Aggregates.
   5. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   6. ASTM C150 - Standard Specification for Portland Cement.
   7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   8. ASTM C443 – Joints for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets.

9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.

11. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.

12. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

13. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joints Sealants.

14. ASTM D3753 - Standard Specification for Glass-Fiber-Reinforced Polyester Manholes.

1.3 DESIGN REQUIREMENTS

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in American Concrete Institute (ACI) 350.

B. Design of Lifting Devices for Precast Components: In accordance with ASTM C913.

C. Design of Joints for Precast Components: In accordance with ASTM C913.

D. Watertight precast reinforced air-entrained concrete structures designed to ASTM C890 American Association of State Highway and Transportation Official (AASHTO) HL93 live loading and installation conditions and manufactured to conform to ASTM C913.

E. Minimum 28-day Compressive Strength: 5,000 psi (pounds per square inch).

F. Honeycombed or re-tempered concrete is not permitted.

1.4 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate structure locations, elevations, dimensions, reinforcing requirements, and sizes and elevations of penetrations.

C. Product Data: Submit cover and frame construction, features, configuration, dimensions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with the Owner's current adopted Standards and the contract Drawing and Specifications.

1.7 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

B. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast concrete structural products.

C. Store precast concrete structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.

PART 2 PRODUCTS

2.1 MANHOLES AND STRUCTURES

A. Manhole and Structure Sections: In accordance with Clifton Sanitation District Specifications and Standard Drawings.

B. Precast Vaults and Boxes: Conform to ASTM C-858 with a minimum wall thickness of eight inches.

C. Design concrete mix to produce required concrete strength, air-entrainment, watertight properties, and loading requirements.

2.2 FRAMES AND COVERS

A. Manufacturers: In accordance with Clifton Sanitation District Specifications and Standard Drawings.

1. D&L Foundry
2. EJ
3. Barry Pattern and Foundry Co., Inc.
4. Campbell Foundry Co.
5. McKinley Iron Works
6. Neenah Foundry Co.
7. Substitutions: Section 01 60 00 – Product Requirements.

B. Product Description: In accordance with Clifton Sanitation District Specifications and Standard Drawings.

C. Size: As indicated on the Drawings.

2.3 COMPONENTS

A. Manhole Components: In accordance with Clifton Sanitation District Specifications and Standard Drawings

B. Other Structure Components:
   1. Steps: Polypropylene plastic covered galvanized steel reinforced bar rungs; 1/2-inch diameter, meeting ASTM C478, ASTM D4101, and ASTM A615.
   2. Grout: As specified in Section 03 30 00 - Cast-in-Place Concrete.
   3. Gaskets: Conform to ASTM C-443, or Ram-Nek Sealant or approved equivalent.
   4. Structure Connectors: Conform to ASTM C923.
   5. Bedding: Structural Fill aggregate material as specified in Section 31 05 16.

2.4 CONFIGURATION

A. Manholes: In accordance with Clifton Sanitation District Specifications and Standard Drawings.

B. Other Structures:
   1. Shape: As indicated on Drawings.

C. Clear Inside Dimensions: As indicated on Drawings.

D. Design Depth: As indicated on Drawings.

E. Piping Connections: As indicated on Drawings.

F. Clear Cover Opening: 30 inches diameter minimum, and as indicated on Drawings.

G. Grade Rings: As indicated on Drawings.

H. Steps: 12 inches wide, 12 inches on center vertically, set into manhole and structure wall as indicated on Drawings.

2.5 FOUNDATION AND BACKFILL MATERIALS

A. Foundation: Structural fill type as specified in Part 2.1(a) of Section 31 05 16 and the Geotechnical Report.

B. Backfill: Granular backfill type as specified in Part 2.1(b) of Section 31 05 16 and the Geotechnical Report.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions are as shown in Contract Documents before starting work.

B. Verify items provided by other sections of Work are properly sized and located.

C. Verify built-in items are in proper location, and ready for roughing into Work.

D. Verify correct size of structure excavation.

3.2 PREPARATION

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

3.3 INSTALLATION

A. Excavation and Backfill:

1. Excavate for structures in accordance with Section 31 23 16 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.
2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes and structures in dry trench.
3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

B. Place base pad, trowel top surface level.

C. Place structure sections plumb and level, trim to correct elevations, anchor to base pad.

D. Install structures supported at proper grade and alignment as shown on Drawings.

E. Backfill excavations for structures in accordance with Section 31 23 23.

F. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour to form continuous drainage channel as indicated on Drawings.

G. Set cover frames and covers level without tipping, to correct elevations.

H. Coordinate with other sections of Work to provide correct size, shape, and location.

I. Subgrade stabilization includes over excavation followed by installing 3- to 4-inch diameter, clean, angular cobbles into the subgrade to create a working surface over the exposed subgrade. Following subgrade stabilization, an approved separation geotextile should be placed over the stabilized subgrade to prevent intrusion of fine-grained subgrade soils into the structural fill. Structural fill may then be placed and compacted over the geotextile.

3.4 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION

A. Lift precast components at lifting points designated by manufacturer.

B. When lowering structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

C. Set precast structures bearing firmly and fully on structural fill bedding, compacted in accordance with provisions of Section 31 23 23 or on other support system shown on Drawings.

D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.

F. Joint sealing materials may be installed on site or at manufacturer's plant.

G. Verify structures installed satisfy required alignment and grade.

H. Remove knockouts or cut structure to receive piping or conduit without creating openings larger than required to receive pipe or conduit. Fill annular space with grout and caulk perimeter of opening.

I. Cut pipe to finish flush with interior of structure.

J. Shape inverts through manhole and structures as shown on Drawings.

3.5 FRAME AND COVER INSTALLATION

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

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 – Quality Requirements, Section 01 70 00 – Execution and Closeout Procedures: Field inspecting, testing, adjusting, and balancing.

B. Test concrete manhole and structure sections in accordance with ASTM C497.

C. Test cast-in-place concrete in accordance with Section 03 30 00 – Cast-in-Place Concrete.

D. Vertical Adjustment of Existing Manholes and Structures:

1. Where required, adjust top elevation of existing manholes and structures to finished grades shown on Drawings.

2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated on Drawings.

4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03 30 00.

END OF SECTION

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SECTION 40 06 10
PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and Fitting Systems

B. Pipe Penetration Seals

C. Couplings

D. Mechanical Joint Restraints

E. Thrust Block

F. Hardware

G. Pipe Testing

H. Valve Boxes

I. Location Wire and Marking Tape

J. Appendix A – Pipe System Data Tables

1. PVC01 – Drain pipe to wet well

2. PVC02/03 – Reference Tech Spec 2, Section 102.7 for PVC gravity sewer

3. PVC04/05 – Reference Tech Specs 2, Section 102.7 for PVC pressure sewer

4. PVC10 – Ozone pipe

5. DI02 – All DI pipe in lift station

6. SST01 – Wet well bypass pipe

1.2 REFERENCES

A. ASTM D1330: Standard Specification for Rubber Sheet Gaskets

B. ASTM D5162: Standard Specification for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

C. ASTM F2164: Standard Specification for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems using Hydrostatic Pressure

D. ASTM F2618: Standard Specification for Chlorinated Poly Vinyl Chloride (CPVC) Pipe and Fittings for Chemical Waste Drainage up to 220°F

E. International Building Code (IBC), current edition adopted by local jurisdiction.

F. Uniform Plumbing Code (UPC), current edition adopted by local jurisdiction.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 Submittal Procedures.

B. Submit manufacturer's certification under provisions of Section 01 33 00 Submittal Procedures that product(s) meet or exceed the specified requirements.

C. Submit manufacturer's installation instructions.

D. Submit shop drawings for all piping four inches in diameter or larger. Shop drawings shall show accurate dimensions of the piping system to be provided including, but not limited to pipe, valves, fittings, connection points to equipment, support system, and appurtenances for all above ground or exposed piping systems. Drawings shall also show connection types. Piping less than four inches in diameter shall be routed as shown on the Plans and to avoid conflicts.

E. Submit restraint calculations for all below ground piping where mechanical restraint will not be provided. Reference Paragraph 2.19 herein.

F. Submit all testing results. Results shall clearly identify which pipe segment was tested (start and end point of piping run), pipe diameter, pipe length, and pipe material. Submitted test data shall include any calculations performed.

1.4 QUALITY ASSURANCE

A. Reference Section 01 40 00 Quality Assurance and Quality Control.

B. The Contract Documents represent the minimum acceptable standards for the Work. All Work shall conform fully in every respect to the requirements of the respective parts and sections of the Contract Documents. The entire unit shall be the Manufacturer's standard product, but shall be modified, redesigned, furnished with special features or accessories, made of materials or provided with finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the Contract Documents.

C. Fabrication shall be done in compliance with all applicable ASTM standards or equivalent international standards.

D. Welding

1. All welders and welding operators shall be qualified by an ASME-approved testing laboratory before performing any welding under this section.

Qualification tests shall be in accordance with Section IX, Article III of the ASME Boiler and Pressure Vessel Code. Welders and welding operators shall be qualified for making groove welds in Type 316L stainless steel pipe in position 6G for each welding process to be used. Welders must be certified and be able to provide proof that less than six months have elapsed since performing a qualified weld.

2. Qualification tests may be waived if evidence of prior qualification is deemed suitable by the Engineer. The manufacturer or Contactor shall retest any welders at any time the Engineer considers the quality of the welder's work substandard. When Engineer requests the retest of a previously qualified welder, the labor costs for the retest will be at the Owner's expense if the welder successfully passes the test. If the welder fails the retest, all cost shall be at the Contractor's sole expense, including any rework required due to substandard work, as defined by the Engineer.

1.5 PROJECT RECORD DOCUMENTS

A. Reference Section 01 70 00 Closeout Requirements.

B. Accurately record actual location of constructed pipe lines, valves, thrust blocks, support systems, and any other component of the piping system in relation to existing permanent benchmarks and/or improvements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Reference Section 01 60 00 Product Requirements.

B. Unload, store, and load pipe in a manner that prevents shock, damage, or excessive exposure to sunlight and weather.

C. Coated pipe shall be shipped on padded bunks with nylon belt tiedown strips or padded banding.

PART 2 MATERIALS

2.1 GENERAL

A. All piping materials, fittings, solvents, primers, welds, or other products and appurtenances used for potable water applications must comply with NSF 61 and be certified Lead-Free.

B. Definitions

1. Pipe installation conditions:

a. Buried: from first exterior joint outside the structure and continuing below grade. Includes piping under slabs between other transition

points when in direct contact with the soil and piping encased in concrete or CDF that is not integrally connected to the structure.

b. Embedded: from first exterior joint outside of the structure to transition point where pipe becomes "inside/exposed" or "submerged". Includes piping passing through or embedded in concrete walls / slabs of structures, grout fills inside structures, masonry, etc.

c. Inside/Exposed: above slabs (within structures) or above grade (exterior) and exposed to air at all times. After transition from "embedded" or "buried".

d. Submerged: from top of wall downward in a liquid containing structure, after transition from "embedded" or “inside/exposed”.

2. Lining vs. coating:

a. Lining applies only to the interior of the pipe and associated appurtenances. Coating applies only to the exterior of the pipe and associated appurtenances.

3. Restraint:

a. Mechanical restraint: requires the use of an appurtenance or a specific joint type to physically prevent the separation of a joint within the pipe system. Joint types which qualify as mechanical restraint include flanged, socket/solvent welded, butt/fusion welded, welded, threaded, grooved, or Vanstone flanged. Specific mechanical joint restraint appurtenances are described in the pipe system data tables.

b. Soil restraint: sufficient pipe length is provided either side of a joint such that the friction between the soil and the pipe is sufficient to prevent joint separation under the testing conditions for the piping system. A separate appurtenance or specific joint type is not required to physically hold the joint together.

c. Reference Paragraph 2.19 herein for additional information.

4. Wall spools vs. sleeves:

a. Wall spools: connect directly to the process piping and directly convey the process liquid or gas.

b. Wall sleeves: provide an opening for the process pipe to pass through. The annular space between the sleeve and the process pipe shall be filled as required by the Plans.

c. Reference the Plans and Paragraphs 2.6 and 2.7 herein for additional information.

2.2 PIPE SCHEDULE

A. The Pipe Schedule is included in the Plans.

2.3 PIPE MATERIAL, JOINTS, AND FITTINGS

A. Reference the appendices for product data tables.

B. Reference Section 40 05 20 Double Containment Piping for single and double-wall containment chemical piping.

C. Filed modification of fittings is not acceptable.

D. All threaded joints shall utilize PTFE tape.

2.4 GASKETS

A. Reference the appendices for product data tables.

2.5 COUPLINGS

A. Reference the appendices for product data tables.

2.6 WALL SPOOLS

A. Wall spools shall incorporate a statically cast thrust collar ring, which is positions to accommodate cast-in-place concrete placements, as shown on the Plans.

B. ANSI/AWWA C150 and C151, ductile iron with connection end type compatible with connecting piping and valving and coordinated with shop drawings and Plan requirements.

C. Minimum lay length 24 inches or as shown on drawings. 350 minimum working pressure,

D. Lining shall be epoxy to match pipe system DI02.

E. Coating shall be as follows:

CONDITION	COATING SYSTEM REQUIRED[A]
Completely embedded in concrete.	System D-1, "Metal, Concrete Encased"
Partially embedded in concrete and extending into a liquid-containing structure. Includes spools which are partially buried, partially embedded in concrete, and partially extended into a liquid containing structure.[B]	System C-1, "Submerged and Intermittently Submerged Metal"
Partially embedded in concrete and extending into a structure that does not contain liquid. This includes spools which are partially buried, partially embedded in concrete, and partially extended into a non-liquid containing structure.	System B-1, "Interior Metal and Piping, Non-Submerged"
Partially embedded in concrete and extending outside of a structure and are exposed only to air	System A-1, "Exterior Metal and Piping, Non-Submerged"

[A]See Section 09 96 00 High Performance Coatings for additional information.

[B] Unless specifically allowed by the Engineer, all spools which extend into a liquid-containing structure shall be coated with System C-1 even if they are above the maximum water surface elevation.

2.7 WALL SLEEVES

A. Reference the Plans for wall sleeve material and construction requirements.

2.8 PIPE PENETRATION SEALS

A. All modular mechanical penetration seals shall be Model S-316 Link-Seal as manufactured by Garlock, or approved equivalent.

1. Seal Element Material: EPDM synthetic rubber; ASTM D20000 M3 BA 510
2. Hardware shall be 316 SS
3. Seal shall be watertight
4. Seal size shall accommodate inlet piping and sleeve opening
5. Backfill remaining annular space with non-shrink, waterproof grout where indicated on the Plans.

B. Manhole adaptors as called out on the Plans shall be KOR-N-SEAL as manufactured by NPC, Inc. or approved equivalent.

1. Adaptor must meet ASTM C923 specifications.

2. Seal shall provide a flexible watertight seal of the pipe to the manhole or concrete structure. No adhesives or lubricants shall be employed in the installation of the connector into the manhole.

3. All hardware shall be stainless steel. Stainless steel elements of the connector shall be totally non-magnetic Series 304 Stainless, excluding the worm screw for tightening the steel band around the pipe which shall be Series 305 Stainless. The work screw for tightening the steel band shall be torqued by a break-away torque wrench and set for 60-70 inch/lbs.

4. The connector shall be of a size specifically designed for the pipe material and size being installed.

2.9 THRUST BLOCKS

A. Concrete for thrust blocks shall conform to Section 03 30 00 Cast-in-Place Concrete of these Specifications.

B. Reference the Plans for additional thrust block requirements.

2.10 HARDWARE

A. Unless otherwise shown or specified:

1. All buried nuts, bolts, and washers shall be zinc plated for corrosion protection.

2. Mechanical joint T-bolts shall be lugged (Corten style). All bolts shall be manufactured in accordance with ANSI/AWWA C111/A21.11.

3. Exposed, embedded, or submerged nuts, bolts, and washers shall be 304 or 316 stainless steel.

4. During assembly of interior piping, provide aluminum based anti-seize lubricant on all bolt threads.

2.11 VALVE BOXES

A. Provide adjustable cast iron valve boxes and lid, as shown on the Plans.

B. Provide PVC plastic valve lid insert (beneath the lid) to retain gravel and debris from entering the valve box.

1. Manufacturer: Sealing Systems, Inc. Valve Box Inserts, or equal.

2.12 PIPE SADDLE TAPS

A. For ductile iron pipe, 2- to 30-inch diameter: Ford Style FC202 with double-wide stainless steel band and fusion epoxy coated body, ROMAC Style 202S, or approved equivalent. 150 psi minimum working pressure. Hardware shall be stainless steel.

B. For PVC, CPVC, or polyethylene pipe, 12-inch diameter and smaller, and for chemical service: Spears Manufacturing Company Schedule 80 Clamp-on Saddles or approved equivalent. O-rings shall be compatible with pipe contents. Hardware shall be stainless steel. 150 psi minimum working pressure. Provide socket or threaded outlet connection as required by connecting pipe system. All components of the saddle shall be compatible with the chemical(s) utilized within the process piping.

C. For PVC pipe, up to 30-in diameter, for non-chemical service: Ford Style FC202 with double-wide stainless steel band and fusion epoxy coated body, ROMAC Style 202S, or approved equivalent. 150 psi minimum working pressure. Hardware shall be stainless steel.

D. For stainless steel pipe, Schedule 10S to Schedule 40: ROMAC Style 306 or approved equivalent. All metal components, including hardware, shall be 304 stainless steel. Gasket shall be NBR or as required for compatibility with the process liquid. Saddle shall meet the requirements of ANSI/AWWA C800. Minimum working pressure of 150 psi.

2.13 HOT TAPPING SLEEVE

A. Hot tapping shall only be provided where specifically noted on the Plans or as otherwise deemed acceptable by the Engineer.

B. Hot tapping style stainless steel sleeve shall have a minimum working pressure rating of 150 psi. Sleeves shall be sized to the outside diameter of the existing pipe to be tapped with a water outlet size as called out on the Plans. Fasteners shall be Type 304, Grade 18-8, stainless steel, and be a minimum size of ¾ inch. Tightening nuts shall be positioned on the flange side of the tapping sleeve. Flanges shall conform to AWWA C207, Class D, with 150 lb. drill hole pattern, and be stainless steel, Grade 18 8, Type 304. Gasket material shall be approved for potable water service per NSF standards. Product manufacturer shall be Ford FAST style tapping sleeve, Romac tapping sleeve, or approved equivalent.

2.14 PIPE CAPS

A. Provide mechanically restrained MJ or flanged ductile iron end caps for pipe abandonment, or where specifically noted on the Plans. Pipe caps shall be coated to match the adjacent pipe system. Caps shall meet the requirements of ASTM A536, ANSI/AWWA C153/A21.53, and ANSI/AWWA C111/A21.11.

2.15 LOCATING WIRE AND MARKING TAPE

A. All buried piping shall have marking tape and locating wire. Provide a valve box at pipe termination point for accessing locating wire.

B. Locating Wire:

1. Locating wire used in open trench construction shall be #12 AWG high strength copper clad steel with minimum 450 lb. break load. Wire shall be insulated with high density polyethylene (HDPE) insulation intended for direct bury. Minimum thickness shall be 30 mil. Insulation shall be color coded as described herein.

    a. Manufacturer: Copperhead 1230-HS or equal

2. Wire connectors shall be specifically manufactured for use in underground locate wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner so as to prevent any uninsulated wire exposure. Non-locking friction fit, twist on (aka wire nuts), or taped connectors are prohibited.

    a. Manufacturer: Copperhead Snakebite Locking Connectors or equal

C. Contractor shall demonstrate correct installation to the engineer by performing a locate/conductivity test for each pipe run.

D. Marking Tape:

1. Material: 75 mm (3 inch), 4 mil polyethylene.

2. Color: marking tape shall be color-coded as described herein.

3. Labeling: Label marking tape with the designated pipe use as described herein using 1-1/2 inch minimum black lettering in all capital letters.

    a. All natural gas, electric power lines, communication/signal lines, potable water, non-potable water, and air lines shall be labeled as such.

    b. Chemical lines shall be custom labeled to reflect the actual chemical contained within the piping. Submit proposed labeling to Engineer for review.

    c. All other process pipe types shall be labeled as “SEWER”.

E. Color Code:

1. Natural gas: yellow

2. Electric power lines: red

3. Communication or signal lines: orange

4. Potable water: blue

5. Non-potable water: purple

6. Chemical: white

7. Air: yellow

8. All other piping: green

2.16 PIPE INSULATION AND JACKETING

A. Match existing insulation and jacketing where connecting to existing systems.

B. Underground Piping:

1. Unless specifically noted otherwise, all buried piping that has less than 4-ft of cover based on final grade shall be provided with DOW Highload 40 insulation in sufficient thickness to equate to 4-ft of bury.

2. Where specifically denoted on the Plans, provide cellular glass pipe insulation. Jacketing shall be precut to fit the contour of the surface to which it is to be applied. Precut sections shall allow for 2-inch overlap. All laps shall be sealed with a glove coat of manufacturer's seal coat. Butt straps shall be identical in all respects and appearance to the basic jacket material. Insulation thickness, and number of layers required, shall be as recommended by the manufacturer to maintain the required temperature noted on the Plans.

a. Manufacturer: Owens Corning FOAMGLAS insulation pipe shells with Owens Corning "PITTWRAP HS Jacketing" or equal.

C. Exterior Exposed and Interior Exposed Piping Insulation

1. Protection against freezing: All exterior exposed piping shall be provided with electric heat trace and insulation unless specifically noted otherwise.

2. Interior exposed piping shall only be provided with insulation where specifically denoted on the Plans.

3. Insulation Requirements:

a. Where operating temperatures are between 0- and 850-degress Fahrenheit, provide performed fiberglass pipe insulation with factory applied all-service vapor-retarder jacket with a self-sealing longitudinal closure lap and butt strips. Insulation thickness, and number of layers required, shall be as recommended by the manufacturer to maintain the required temperature as noted on the Plans. Where nested insulation is utilized, the exposed ends of the insulation shall be coated in mastic. Install in accordance with all manufacturer's requirements and recommendations.

i. Manufacturer: JM Micro-Lok HP, Owens Corning SSL II, or equal.

b. Where flanges, couplings, elbows, tees, or valves prevent the nesting of pipe insulation from creating a continuous seal, provide molded PVC covers. PVC is required to provide a vapor barrier for non-continuously sealed nested insulation under metal jacketing systems.

i. Manufacturer: Zeston 2000/300 fittings, or equal

D. Exterior Exposed and Interior Exposed Piping Insulation Jacket

1. All exterior exposed piping shall be jacketed with an Aluminum, PVC, or stainless-steel jacket, as noted on the Plans.

2. Provide protective jacketing over interior exposed insulation where specifically noted on the Plans.

a. Material:

i. Aluminum: Johns Manville Aluminum Jacket with Ell-Jacs Aluminum Elbow Covers

ii. Stainless Steel: Johns Manville stainless steel Jacket with Ell-Jacs Stainless-Steel Elbow Covers

iii. PVC: UV resistant Zeston 30 mil PVC Jacketing with Zeston 2000/300 fittings, or equal.

2.17 DIELECTRIC UNIONS AND INSULATION FLANGES

A. Dielectric unions or insulating flanges shall be used to separate all dissimilar metal pipe connections and wherever buried ferrous metal pipe transitions to above grade.

2.18 LUBRICANTS

A. Pipe lubricants shall be supplied by the pipe manufacturer. No substitutes for lubricants from other manufacturers will be allowed.

2.19 RESTRAINT

A. Provide restrained joints, unless otherwise specified.

B. Acceptable types of restraint include:

1. Fittings (regardless of location): All fittings shall be restrained by mechanical joint restraint.

2. Valves (regardless of location): All valves shall be restrained by mechanical joint restraint.

3. Dead Ends (regardless of location): All dead ends (e.g., caps, blind flanges…etc.) shall be restrained by mechanical joint restraint.

4. Couplings (regardless of location): All couplings shall be restrained by mechanical joint restraint unless specifically noted otherwise.

    a. For buried pipe, straight coupling joints shall be mechanically restrained unless the coupling does not fall within the required minimum restrained length on both sides of the joint. Where mechanical restraint is required, provide external restraint appurtenance.

5. Buried or Embedded Pipe:

    a. Thrust Blocks: Provide thrust blocks under all buried valves and at other locations specifically indicated on the Plans.. Thrust blocks shown at fittings, valves, and dead ends shall be provided in addition to mechanical joint restraint.

        i. Provide bearing area against undisturbed earth.

        ii. Place thrust blocks such that fitting can be removed at a later date without damage to the pipeline.

        iii. Place concrete so no concrete touches the nuts and bolts of the fitting or valve, and the nuts and bolts can be removed and replaced without removing any concrete.

        iv. Reference the Plans for additional requirements.

    b. Mechanical Restraint: provide mechanical restraint appurtenance at all joints within the calculated minimum restrained length.

    c. Restraint by Soil Friction: restraint due to soil friction is sufficient for all pipe-to-pipe joints outside of the calculated minimum restrained length.

    d. Minimum Restrained Length: The minimum restrained length is a calculated distance from the end of a fitting, valve, or dead end (e.g., cap, blind flange…etc.) for which all joints must be mechanically restrained. Unless otherwise required by local, state, or federal codes and regulations, the minimum restrained length shall be as follows:

        i. For horizontal pipes with four feet of cover and a test pressure of 150 psi, the minimum restrained length shall be as shown in the following table:

Pipe Size (in)	Minimum Restrained Length					
	Fitting Angle				Valve or Dead End	Branch of Tee[a]
	11.25°	22.5°	45°	90°		
4	2	3	5	12	38	0
6	2	4	7	17	53	0
8	3	5	9	22	68	2
10	3	5	11	25	80	14
12	3	6	13	30	93	28
14	4	7	14	33	104	40
16	4	8	16	37	116	52
18	4	9	17	41	126	63
20	5	9	19	44	137	74
24	5	11	21	51	155	93
30	6	12	25	60	180	119
36	7	14	28	68	202	142
42[b]	6	12	25	59	122	89
48[b]	7	13	27	64	131	99

(a) Note, either side of the tee run shall be fully restrained with a mechanical restraint appurtenance for a minimum of 10 feet.

(b) Assumes pipe is ductile iron. If alternate material is used, Contractor shall submit revised minimum restrained length calculations for review by the Engineer.

e. Where the excavation/trench extends into an area that has groundwater at any time of the year, the minimum restrained lengths do not apply, and all joints and fittings shall be fully restrained utilizing mechanical restraint appurtenances.

f. Contractor shall provide additional mechanical restraint appurtenances for pressure testing purposes. Specifically, where plugs are installed for pressure testing, a dead end is created and all joints within the minimum required restrained length from this plug shall be

mechanically restrained. Contractor shall leave the restraints in place upon completion of the pressure test.

g. Where valves, fittings, or other appurtenances are added to an existing pipeline, the Contractor shall mechanically restrain the existing joints for the minimum required restrained length on all sides of the new component.

h. All joints between a tee and a hydrant/hose bibb shall be fully restrained utilizing mechanical restraint appurtenances regardless of the distance between the tee and the hydrant/hose bibb.

i. Listed lengths are based on a test pressure of 150 psi. To compute the length for a different test pressure for bends, valves, or dead ends, use the following equation, where all lengths shall be rounded up to the nearest foot:

$$Length = \left(\frac{Test\ \ Pr\,e\,ssure}{150}\right)\ (Table\ Value)$$

For tees, consult the Engineer for the minimum required restrained length at different test pressures.

j. Listed lengths assume a well graded condition with little to no fines. If conditions are different, verify minimum restrained lengths with supplier.

k. Contractor shall submit calculations for minimum restrained lengths for the following scenarios, at minimum:

   i. Non-horizontal pipe installations

   ii. Test pressures greater than 150 psi

   iii. If the pipe is wrapped in plastic

   iv. Bury depth is less than four feet

   v. For 42” and 48” pipe, if the pipe material is not ductile iron

   vi. For each expansion or contraction (i.e., reducers) in the piping

l. Where the minimum required restrained length is greater than the straight length of pipe available, Contractor shall notify Engineer as alternate means of restraint (e.g., thrust block, thrust collar with anchors…etc.) are required. Contractor shall provide alternate means of restraint at no additional cost to the Owner.

   i. For tees where the straight run of piping on the branch is insufficient to provide the minimum restrained length, the

straight run of piping on either side of the tee run may require a longer minimum restrained length than 10 feet. Contractor shall notify the Engineer and provide mechanical restraint appurtenances for the length determined by the Engineer for all sides of the tee at no additional cost to the Owner.

6. Interior, Exposed, and Submerged Pipe:

a. Mechanical Restraint: provide mechanical restraint at all joints.

C. All mechanical restraint appurtenances shall be coated with fusion bonded epoxy, unless specifically noted otherwise.

PART 3 EXECUTION

3.1 GENERAL

A. Pipe and associated appurtenance shall be installed in accordance with good trade practice and in strict accordance with the manufacturer's instructions, recommendations, and requirements. The methods employed in the handling and placing of pipe, fittings, and equipment shall be such as to ensure that after installation and testing they are in good condition, as determined by the Engineer.

B. When pipe installation is not progress, block or plug all openings not actively undergoing connection/installation to prevent debris and wildlife from entering the piping.

C. All pipe and fitting joints shall be restrained. Reference Paragraph 2.19 of this Specification.

3.2 EXAMINATIONS

A. Verify excavation meets the requirements of Section 31 23 16 Excavation.

B. Verify that excavations are to required alignment, grades, dry, and not over excavated.

C. Verify that excavation will allow a minimum pipe cover as shown on the Plans and as described elsewhere in the Specifications.

1. Where specific pipe elevations are not stated and new piping is to be connected to existing pipelines which have less than the minimum required cover: connect to existing pipeline and angle pipe, as necessary, to achieve cover requirements.

2. Where specific pipe elevations are provided, if the cover is less than four feet, provide insulation as described in this Section.

D. Verify materials delivered to the site meet the requirements of these Technical Specifications. Examine materials for defects or damage. Defective or damaged products shall not be incorporated into the Work.

E. Examine existing piping locations and structures where connections are to be made. Notify Engineer of any discrepancies.

F. Verify equipment locations. Notify Engineer, prior to ordering parts, if modifications are required to properly connect the piping to the equipment.

3.3 NATURAL GAS PIPING INSTALLATION

A. Install in accordance with local gas codes and requirements, including the gas provider's requirements for materials, trenching, backfilling, testing, etc.

3.4 PLUMBING INSTALLATION: WATER AND DRAIN PIPING

A. Install horizontal runs at a minimum slope of 1/8-inch per foot, unless noted otherwise, and in accordance with local plumbing codes.

3.5 COMPRESSED AIR (INSTRUMENT AIR) PIPING INSTALLATION

A. Routing of instrument air piping is the responsibility of the Contractor in conformance with Contract Documents. Air piping shall be routed to prevent conflict with all other components of the Work. Piping and fittings must conform to ASME B31.1.

B. Piping and fittings must meet the design temperature, pressure, and environment of the system.

C. Horizontal pipe runs should be installed at a grade of at least one inch per 100 feet and drain valves should provide at low points.

D. Provide isolation ball valves at all branch lines and at each instrument.

E. Provide fittings, pipe hangars, brackets, clamps, dielectric unions, etc. as necessary to route piping to point of use.

F. Contractor is required to provide adequately sized piping/tubing as required to operate the instruments on each branch line. Unless otherwise indicated, provide ½-inch diameter minimum for a line serving a single instrument; 1-inch diameter minimum for any line serving two or more instruments.

G. Unless otherwise noted for underground installation use HDPE or stainless-steel materials.

H. Unless otherwise noted for aboveground installation should use Stainless steel, painted copper, or aluminum.

I. Air-flush all lines prior to connection to instruments or valves.

J. Tubing:

1. Provide HDPE or Polypropylene ½-inch OD x 3/8-inch ID poly tubing between instrument isolation valve and the instrument or valve. Poly tubing shall be no

longer than 3 ft and shall have adequate slack to allow disconnection from the instrument or valve.

2. Contractor shall route tubing such that access to valves, process piping, equipment and electrical components is not limited or obstructed.

3.6 BURIED AND EMBEDDED PIPE INSTALLATION

A. All connections with existing piping or components shall be potholed and checked for material, size, connection type, and space available for connection prior to making the connection. Contractor shall provide all parts necessary for the connection at no additional cost to the Owner. Contractor shall submit verification to the Engineer of all potholes confirming that no conflicts exist, and that Contractor has all parts and equipment required for the connection readily available onsite. Verification shall be submitted at least 24 hours in advance of the planned connection date and time.

B. Contractor shall coordinate all outages and/or shutdowns required for connecting to existing piping currently in use per Section 01 32 17 Work Sequence.

C. Remove all water from excavation.

D. Install pipe in accordance with the manufacturer's recommendations and requirements.

E. Utilize proper tools for cutting and beveling pipe ends. Join pipe using manufacturer's recommended tools designed for this task.

F. Clean and prepare pipe joint using manufacturer's recommended gasket and lubricant.

G. Utilize proper tools to complete joint. For bell and spigot pipe, assure that the plain end is inserted "home" in the bell.

H. Assure that no dirt or other foreign material is allowed in the pipeline. Plug all pipe ends with watertight plugs when leaving the pipe unattended.

I. Complete trenching and backfilling for utilities in accordance with Section 31 23 33 Backfilling and Compacting for Utilities.

J. Install pipe fittings so a constant alignment and grade is achieved through all the pipe and fittings between the elevations stated on the Drawings.

K. Install pipelines to the alignments and grades shown on the Drawings.

L. Properly align pipe perforated slots in trench.

M. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals as shown on the Drawings.

N. Pipes passing beneath or through structure footings/foundations shall have a flexible pipe coupling with longitudinal restraint at each location where a pipe leaves or passes

out from beneath a structure to accommodate potential differential settlement between the structure and pipe. Reference the Drawings for additional information.

3.7 INTERIOR, EXPOSED, AND SUBMERGED PIPING INSTALLATION

A. All connections with existing piping or components shall be checked for material, size, connection type, and space available for connection prior to making the connection. Contractor shall provide all parts necessary for the connection at no additional cost to the Owner. Contractor shall submit verification to the Engineer of all connection points confirming that no conflicts exist and that Contractor has all parts and equipment required for the connection readily available onsite. Verification shall be submitted at least 24 hours in advance of the planned connection date and time.

B. Contractor shall coordinate all outages and/or shutdowns required for connecting to existing piping currently in use per Section 01 32 17 Work Sequence.

C. All piping shall be fully supported at all times during and after installation. Equipment or other connected components shall not bear the weight of the piping. No strain shall be induced within the equipment during, or subsequent to, the installation of pipe work. Reference the Plans and Section 40 05 07 Pipe Supports for additional information.

D. Hanging of any pipe from another is prohibited.

E. In erecting the pipe, a sufficient number of unions or flanged joints shall be used to allow any sections or run of pipe to be disconnected without taking down adjacent runs. The Contractor shall provide additional pipe joints as necessary to facilitate delivery and construction of the piping components at no additional cost to the Owner. All additional joints shall be coordinated by the Contractor to prevent conflict with any component of the Work. Contractor shall submit the locations of additional joints to the Engineer for review for all pipes larger than 2-inch in diameter.

F. Flexible couplings shall be installed where shown on the Drawings. Additional flexible couples shall be provided for ease of installation or removal of the pipe at no additional cost to the Owner. Contractor shall coordinate to prevent conflict with any component of the work. Contractor shall submit the locations of additional flexible couplings to the Engineer for review for all pipes larger than 2-inch in diameter.

3.8 PIPE PENETRATION INSTALLATION

A. All penetrations shall be installed with the associated formwork prior to the concrete pour. Blockouts and pour-backs shall not be acceptable unless prior consent is received from the Engineer. Where allowed, blockouts and pour-backs may require additional Work which shall be at the Contractor’s soul expense.

3.9 PIPING INSULATION INSTALLATION

A. General: Pipe insulation shall be continuous and installed on all fittings and appurtenances unless specified otherwise. Installation shall be with full-length units of

insulation and using a single-cut piece to complete a run. Provide jackets for all pipe insulation.

1. Install material in accordance with the manufacturer's written instructions.

2. Locate insulation and cover seams in least visible locations.

3. Do not apply insulation until pipe tests and heat tracing is completed.

4. Do not apply insulation over flanged joints until piping has been brought up to operating temperature and flange bolts have been fully tightened.

5. Remove material such as rust, scale, dirt and moisture from surfaces to receive insulation.

6. Neatly finish insulation at supports, protrusions, and interruptions.

7. Provide insulated dual temperature with vapor retardant jackets with self-sealing laps. Insulate complete system.

8. Stagger joints on multi-layer insulation.

9. Mix mineral fiber thermal insulating cement with demineralized water when used on stainless steel surfaces.

B. Joints: Joints shall have adjacent sections tightly butted with jackets drawn tight and smoothly cemented down on all longitudinal and end laps. Jacket longitudinal laps shall overlap by at least 1-1/2”, unless noted otherwise by the manufacturer. Butt joints shall be sealed with pressure-sensitive vapor barrier tape.

1. Jacket laps, butt strips, and exposed ends of insulation shall be cement sealed using either adhesive or factory-applied, self-sealing system. Jacket laps shall be smooth and without fishmouths.

C. Laps: Unless noted otherwise by the manufacturer, self-sealing laps (1-1/2” minimum) and butt strips (3” minimum width) shall be used for sealing insulation joints. Staple with outward clinching staples on 4” centers on side laps and 4” on centers to both butted jackets for butt strips. If any open gaps occur, add staples and lagging adhesive or replace jacket totally.

1. For cold applications, provide lagging adhesive on all staples.

D. Insulation Support at Hangers:

1. For all piping 1-1/2” in diameter or larger, provide support shield between piping and hanger to prevent damage to the insulation. Shield shall be fabricated of 14-gauge stainless steel sheet metal, unless specifically noted otherwise. Insulation shields and inserts shall be not less than the following lengths.

1-1/2” to 2-1/2” pipe size	10” long
3” to 6” pipe size	12” long
8” to 10” pipe size	16” long
12” and larger pipe size	22” long

2. Provide vapor barrier per insulation manufacturer’s recommendations to prevent condensation.

E. Sleeves and Wall Chases: Insulation on pipes through walls and floors shall be full size and jacketed same as adjacent insulation. Provide a metal jacket over the insulation on pipe passing through sleeves in non-fire rated walls where caulking is required.

1. Where penetrating interior walls, extend the metal jacket 2 inches out on either side of the wall and secure on each end with a band.

2. Provide adequate support on vertical pipe to prevent slipping.

3.10 PIPING COLOR CODE AND IDENTIFICATION

A. General:

1. Unless required otherwise by the Engineer, all exposed process and building piping and accessories shall be identified and painted as specified herein and in conformance with this specification.

2. The following piping materials need not be completely painted with the basic identification color; colored bands may be provided instead for the following:

a. Stainless steel

b. Chrome-plated piping

c. Interior HDPE Chemical Piping

d. Interior PVC/CPVC Chemical Piping

3. Where piping is to be identified with colored bands, a three-band system shall be used. The background color, as identified on the pipe schedule, shall appear in the left and right-most bands, with the secondary color located in the center. For piping with only a single identifying color, a single colored band shall be provided.

4. All PVC piping that extends to the exterior of buildings/structures (i.e., exposed to UV/sunlight) shall be painted completely. Submit to coordinate color with process identification and architectural elements.

5. The entire exposed surface of all other piping and accessories shall be painted according to the color codes indicated in the pipe schedule.

B. Identification Labels:

1. Identify all exposed piping and all piping on each side of each valve; on each side of a branch; on both sides and adjacent to each wall and floor penetration, and at 15 feet on center (maximum spacing between labels).

2. All chemical piping shall be identified a minimum of two (2) times in each interior room.

3. Identification Label Requirements:

a. Name of service as shown on Plans

b. Flow direction arrows

c. Position identification so that it is readily visible from eye level.

d. Block letters neatly stenciled on the finished insulation or pipe with flat black or white enamel contrasting the background pipe color. Label/Text size shall be as noted below. In some instances, as an alternative to painting of identification, an adhesive decal pipe identification system may be acceptable upon review by the Engineer. Contractor shall submit product information for review by Owner and Engineer as an alternative to painted identification.

SIZE OF LETTERS / ARROWS	
Outside Diameter of Pipe or Covering	**Height of Stencil Letter**
¾" to 1¼"	½"
1½" to 2"	¾"
2½" to 6"	1¼"
8" to 10"	2½"
Over 10"	3½"

3.11 PRESSURE TESTING

A. Refer to the Pipe Schedule within the Plans for pipelines which shall be pressure tested, the testing pressure, and testing method.

B. Pressure testing and preparation for pressure testing shall not be done when the temperature is anticipated to be at or below 32°F. Confirm ambient temperatures with Engineer prior to beginning pressure test preparations.

C. Pressure testing shall not be done until all appurtenances required by the Contract Documents, including but not limited to valves, instruments, and pipe supports, have been installed.

D. Pressure taps for test plugs shall be ½-inch FNPT unless otherwise specified.

E. Assure that the trench is properly backfilled and compacted, and thrust blocking has cured for 28 days in order to prevent damage or pipe/fitting movement. Pressure testing shall occur prior to surface restoration and prior to any structure or portion thereof being constructed above the pipe. This may require the pipe to be pressure tested in segments. All pipelines shall pass pressure testing before completing surface repair. If the Contractor chooses to provide surface repair prior to achieving passing pressure tests for all pipes, the Contractor shall bear all costs associated with any additional surface repair which may be required.

F. Provide additional pipe restraint to obtain minimum required restrained length from pipe plugs. See Paragraph 2.19.

G. Remove all construction debris from piping prior to pressure testing. Flush all piping with potable water at a minimum velocity of 2.5 fps. Flushing activities shall continue until flush water appears clean and free of debris, in the opinion of the Engineer. Dispose of water per local, state, and federal requirements.

H. Test Methods:

1. Test Type: G (Gravity)

   a. Per International Plumbing Code if indicated on the Pipe Schedule.

   b. Hydrostatically test the pipeline to 25 psi.

2. Test Type: H (Hydrostatic)

   a. Pressure test HDPE pipe per ASTM F2164-02 “Field Leak Testing of Polyethylene (PE) Pressure Piping Systems using Hydrostatic Pressure”.

   b. For all other pipe materials, fill pipe with water to the pressure shown on piping schedule. Expel all air.

   c. Verify that, in a two-hour (2) test, the pipe does not leak in excess of the allowable leakage, as defined by the following formula:

$$Q = \frac{LD\sqrt{P}}{148{,}000}$$

Where:

Q = allowable leakage (gallons per hour)

L = length of pipe section being tested (feet)

D = nominal pipe diameter (inches)

P = average test pressure during the hydrostatic test (psi)

3. Test Type P (Pneumatic)

   a. Pneumatic testing shall only be allowed where specifically noted as acceptable by the Engineer.

   b. Pneumatic testing, where allowed, shall be per ISPWC Section 501 – Gravity Sewers, Paragraph 3.4.C with pressure as indicated on the Pipe Schedule

4. Certify test results meet these specifications and submit all results and Contractor's certification to the Engineer.

3.12 MANDREL DEFLECTION TESTING

A. If specified in the Pipe Schedule, provide mandrel deflection testing no sooner than 30 days after trench backfill and compaction is completed.

B. Deflection testing shall be conducted and all pipelines shall pass deflection testing before completing surface repair. If the Contractor chooses to provide surface repair prior to achieving passing deflection tests for all pipes, the Contractor shall bear all costs associated with any additional surface repair which may be required.

C. The maximum allowable deflection is to be 5.0% of the nominal pipe diameter.

D. Provide test mandrels with a diameter at least 95% of the actual inside diameter (ID) of the pipe. For pipes with controlled outside diameter, calculate the actual ID of the pipe by taking the average outside diameter (OD) as set by the ASTM standard and subtracting two (2) times the minimum wall thickness as set by the ASTM standard. For pipes with controlled inside diameter, use the ID set by the ASTM standard.

E. Pull the appropriate mandrel through the pipe using one of the following methods:

   1. Pull the mandrel through the pipe by hand. If the pipe will not allow the mandrel to pass, repeat the test from the opposite direction to determine the limits of failure. If the mandrel cannot pass through the entirety of the pipe, the pipe is considered to have failed the deflection test.

   2. As a part of the CCTV inspection, see Section 33 01 00 TV Inspection of Gravity Pipelines, pull the mandrel through the pipe by connecting it in front of the CCTV camera lens at a distance equal to the camera's focal length. Notify Engineer of time and date of test at least 24 hours prior to testing to allow for Engineer, at Engineer's discretion, to witness test. Provide tag line to reverse mandrel and camera should mandrel fail to pass through line. Perform test as a separate step from the CCTV inspection, where required, thus a separate DVD or digital video file record must be made of the mandrel test. Clearly mark tape identifying project name, mandrel test, and the pipe will not allow the mandrel to pass, repeat the test from the opposite direction to determine the limits of failure. If the mandrel cannot pass through the entirety of the pipe, the pipe is considered to have failed the deflection test.

F. Uncover and, if required by the Engineer, remove and reinstall new pipe sections for reaches with excessive deflection (i.e., which have failed the deflection test) or recompact bedding if, in the opinion of the Engineer, existing pipe is not damaged. Retest pipe after any repair work is completed. Do not reinstall damaged pipe.

G. The Owner may conduct additional deflection testing at their own cost prior to expiration of the warranty period. If a pipe is found to have excessive deflection (i.e., fail the deflection test) the Contractor shall uncover and provide new pipe that meets all requirements herein at no additional cost to the Owner. Contractor shall also provide additional testing of the replacement pipe until the pipe passes all required tests at no additional cost to the Owner. Do not reinstall damaged pipe.

3.13 LOCATING WIRE AND MARKING TAPE

A. Place locating wire and marking tape at the locations shown on the plans for the entire length of a pipeline. Repair all cuts and splices in accordance with the manufacturer's recommendations. Assure continuity of all locating wire before submitting final payment. Payment will not be made for pipe where the locating wire does not have electrical continuity.

3.14 DISINFECTION OF POTABLE WATER LINES

A. Provide disinfection of potable water lines in accordance with Section 33 01 11 Disinfection of Water Distribution Lines.

3.15 TOLERANCES FOR SEWER INTERCEPTOR INSTALLATION

A. The sewer interceptor pipe slope shall conform to the slope set forth in the plans. Reverse slope on gravity pipe is prohibited. Manhole flow channels that pond water are unacceptable. Line segments and manholes not meeting these tolerances shall be rejected and replaced at the Contractor’s expense.

B. The horizontal alignment of the pipeline shall conform to +/- 1-foot from true alignment shown on the plans. The pipeline shall also maintain the separation distance requirement from potable water lines shown on the Contract Documents. Line segments not meeting these tolerances and/or requirements shall be rejected and replaced at the Contractor’s expense.

C. The Contractor shall conduct quality control surveys, at each manhole and as needed throughout sewer interceptor installation, to ensure that project requirements and tolerances are satisfied.

APPENDIX A

Pipe System Data Tables

PVCO1

GENERAL DESCRIPTION:	Small-Diameter Gravity PVC Pipe		
SIZE:	Less than or equal to 12-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	PVC	
	MATERIAL STANDARD:	ASTM D1784 Cell Class 12454 ASTM D1785, Type I, Grade 1 (PVC1120)	
	SCHEDULE OR SDR:	Schedule 40	
	PRESSURE RATING OR CLASS:	130 PSI at 73°F	
PIPE JOINTS			
	TYPE:	Solvent weld	
		JOINT STANDARD:	ASTM D2855
		SOLVENT WELD CEMENT STANDARD:	ASTM D2564
		SOLVENT WELD PRIMER STANDARD:	ASTM F656
		PRESSURE RATING:	78 PSI at 73°F
GASKETS			
	N/A		
FITTINGS			
	MATERIAL:	PVC	
		MATERIAL STANDARD:	ASTM D1784 Cell Class 12454
	TYPE:	Socket	
		FITTING STANDARD:	ASTM D2466
		PRESSURE RATING:	78 PSI at 73°F
HARDWARE			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	See pipe schedule for color.		
	See Section 09 96 00 for coating requirements.		
NOTES			
1.	Buried pipe shall be installed in accordance with ASTM F 1668.		
2.	Fabricated fittings are not permitted.		
3.	FNPT fitting shall have external stainless steel reinforcing band.		
4.	Solvent welds shall use solvent cement and solvent primer in accordance with the manufacturer's recommendations.		
5.	Sun damaged or discolored pipe is not acceptable.		

PVC01

GENERAL DESCRIPTION:	PVC SDR 35 Gravity Sewer Pipe		
SIZE:	4- through 15-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	PVC	
	MATERIAL STANDARD:	ASTM D3034, Cell Class 12454 or 12364	
	SCHEDULE OR SDR:	SDR 35	
	PRESSURE RATING OR CLASS:	Pipe Stiffness of 46 PSI	
PIPE JOINTS			
	TYPE:	Integral Bell Joint	
		JOINT STANDARD:	ASTM D3212
GASKETS			
	TYPE:	Elastomeric, factory installed	
		GASKET STANDARD:	ASTM F477
FITTINGS			
	MATERIAL:	PVC	
		MATERIAL STANDARD:	ASTM D3034 SDR 35
	TYPE:	Solvent Weld – See Note 3	
		FITTING STANDARD:	ASTM D 1784 cell class 12454-B
	TYPE:	Push-on Gasketed	
			ASTM D3212 and F1336
HARDWARE			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	N/A – Buried Piping		
NOTES			
1.	Buried pipe shall be installed in accordance with ASTM D2321.		
2.	Sun damaged or discolored pipe is not acceptable.		
3.	Solvent weld fittings shall only be utilized on pipe less-than or equal-to 15-inch nominal diameter. Cement and primer shall be compatible with the pipe material and the pipe contents. Solvent weld shall meet the criteria of ASTM D2855.		
4.	Suitable couplings complying with ASTM specifications shall be used for joining dissimilar pipes or two plain ends of similar pipe only where bell and spigot are not available.		

PVC02

GENERAL DESCRIPTION:	Large-Diameter Gravity PVC Sewer Pipe		
SIZE:	18- through 48-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	PVC	
	MATERIAL STANDARD:	ASTM F679	
	SCHEDULE OR SDR:	SDR 35	
	PRESSURE RATING OR CLASS:	Pipe stiffness of 46 PSI	
PIPE JOINTS			
	TYPE:	Integral Bell Gasket	
		JOINT STANDARD:	ASTM D3212
GASKETS			
	TYPE:	Rubber, factory installed	
		GASKET STANDARD:	ASTM F477
FITTINGS			
	MATERIAL:	PVC, gasketed	
		MATERIAL STANDARD:	ASTM D3034, SDR 35 Wall Thickness
		FITTING STANDARD:	ASTM F1336
HARDWARE			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	N/A – Buried Piping		
NOTES			
1.	Buried pipe shall be installed in accordance with ASTM D2321.		
2.	Sun damaged or discolored pipe is not acceptable.		

PVC03

GENERAL DESCRIPTION:	Small-Diameter Pressure PVC Pipe		
SIZE:	Less than or equal to 8-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	PVC	
	MATERIAL STANDARD:	ASTM D1785 Type 1, Grade 1 (PVC 1120)	
	SCHEDULE OR SDR:	Schedule 80	
	PRESSURE RATING OR CLASS:	250 PSI at 73°F	
PIPE JOINTS			
	TYPE:	Solvent Weld	
		JOINT STANDARD:	ASTM D2855
		SOLVENT WELD CEMENT STANDARD:	ASTM D2564, See Note 5
		SOLVENT WELD PRIMER STANDARD:	ASTM F656, See Note 5
		PRESSURE RATING:	150 PSI at 73°F
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS			
	MATERIAL:	PVC	
		MATERIAL STANDARD:	ASTM D1784
	TYPE:	Socket, See Note 3	
		FITTING STANDARD:	ASTM D2467
		PRESSURE RATING:	150 PSI at 73°F
	TYPE:	Threaded, See Note 3	
		FITTING STANDARD:	ASTM D2464
		PRESSURE RATING:	125 PSI at 73°F
	TYPE:	Van Stone Flange, See Note 3	
		FITTING STANDARD:	ASTM D2467
		PRESSURE RATING:	150 PSI at 73°F
HARDWARE			
	Hardware shall be 304SST or as required to be chemically compatible with the liquid to be contained within the piping.		
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	See pipe schedule for color.		
	See Section 09 96 00 for coating requirements.		
NOTES			
1.	Buried pipe shall be installed in accordance with ASTM F 1668 and ASTM D2774.		
2.	Piping, solvent cement, solvent primer, and all other appurtenances shall be certified ANSI/NSF-61 lead free for potable water service applications.		

GENERAL DESCRIPTION:	Small-Diameter Pressure PVC Pipe
SIZE:	Less than or equal to 8-inch nominal diameter
NOTES	
3.	Fitting types shall be as follows, unless specifically noted otherwise: a. Socket fittings shall be provided for all buried applications. b. Threaded fittings shall be provided only where specifically indicated on the plans, or as required for connection to system components. FNPT fitting shall have external SS reinforcing band. Threaded fittings shall not be allowed for sodium hydroxide applications. c. Flanged fittings shall be provided only where necessary to connect to valves or other appurtenances in the piping system. Socket unions shall be used preferentially to Van Stone flanges.
4.	Fabricated fittings are not permitted.
5.	For chemical service: solvent welds shall use a solvent cement and primer that are compatible with the chemical being conveyed in the specific process piping. Submit product information and chemical compatibility. Contractor is ultimately responsible for ensuring chemical compatibility.
6.	Clear PVC (where required on the Plans) shall be UV resistant SCH. 80, “Near Water Clear” as manufactured by Harvel, or approved equal.
7.	Sun damaged or discolored pipe is not acceptable.

PVC04

GENERAL DESCRIPTION:	Buried Pressure PVC Pipe		
SIZE:	4- through 48-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	PVC	
	MATERIAL STANDARD:	ANSI/AWWA C900, ASTM D1784 Class 12454	
	SCHEDULE OR SDR:	DR 25 (up to 48" diameter) DR 18 (up to 30" diameter and where specifically required)	
	PRESSURE RATING OR CLASS:	CL 165 PSI (up to 48" diameter) CL 235 PSI (up to 30" diameter and where specifically required)	
PIPE JOINTS			
	TYPE:	Bell and Spigot Ends	
		JOINT STANDARD:	ASTM D3139
		PRESSURE RATING:	165 PSI (unless specifically noted otherwise)
GASKETS			
	TYPE:	Rubber, factory installed	
		GASKET STANDARD:	ASTM F477
FITTINGS			
	MATERIAL:	Ductile Iron	
		MATERIAL STANDARD:	ANSI/AWWA C111/A21.11
	TYPE:	Mechanical	
		FITTING STANDARD:	ANSI/AWWA C110/A21.10 OR C153/A21.53
		PRESSURE RATING:	350 PSI (up to 24" diameter) 250 PSI (30"- 48" diameter)
HARDWARE			
	Hardware shall be 304SST or as required to be chemically compatible with the liquid to be contained within the piping.		
LINING (FITTINGS ONLY)			
	MATERIAL:	Ceramic epoxy Protecto 401 (amine cured Novalac Epoxy), as manufactured by Pacific States Cast Iron Pipe Company; 40 mils nominal dry film thickness. See Note 3 for Potable Water Applications.	

GENERAL DESCRIPTION:	Buried Pressure PVC Pipe	
SIZE:	4- through 48-inch nominal diameter	
COATING (FITTINGS ONLY)		
	MATERIAL:	Asphaltic coating per ANSI/AWWA C151/A21.51 and ANSI/AWWA C110/A21.10; 1 mil nominal dry film thickness.
MECHANICAL RESTRAINT APPURTENANCES		
	PRODUCT:	Wedge action joint restraint glands shall be rated at 350 psi with a 2:1 safety factor. Gland shall be fusion bonded epoxy coated, minimum dry film thickness 20 mils.
	PRODUCT:	PVC Bell and Spigot Push-On Pipe: EBAA Iron, Inc. Series 1900 or 2800 Megalug, or equivalent. Coat with Mega-Bond liquid thermoset epoxy coating per manufacturer's requirements.
	PRODUCT:	MJ Fittings: EBAA Iron, Inc. Series 2000PV or 2200 Megalug, or equivalent. Coat with Mega-Bond liquid thermoset epoxy coating per manufacturer's requirements.
NOTES		
1.	Buried pipe shall be installed in accordance with ASTM F 1668 and ASTM D2774.	
2.	Unless specifically noted otherwise, integral pipe color shall be blue for potable water, purple for non-potable water (i.e., utility water), and green for all other sewer or process services.	
3.	Protecto 401 shall not be used with potable water. Provided standard thickness cement-mortar lining following ANSI/AWWA C104/A21 for potable water applications. Provide Induron Ceramapure PL 90 lining when noted as epoxy-lined pipe/ fittings for potable water applications.	
4.	Sun damaged or discolored pipe is not acceptable.	

PVC10

GENERAL DESCRIPTION:	Pressure CPVC Pipe		
SIZE:	½- through 8-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	Chlorinated Polyvinyl Chloride (CPVC)	
	MATERIAL STANDARD:	ASTM D1784, Cell Classification 23447 ASTM F441, Type IV, Grade 1	
	SCHEDULE OR SDR:	Schedule 80	
	PRESSURE RATING OR CLASS:	250 PSI at 73°F	
PIPE JOINTS			
	TYPE:	Solvent Weld	
		JOINT STANDARD:	ASTM F439
		SOLVENT WELD CEMENT STANDARD:	ASTM F493, See Note 5
		SOLVENT WELD PRIMER STANDARD:	ASTM F656, See Note 5
		PRESSURE RATING:	250 PSI at 73°F
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS			
	MATERIAL:	CPVC	
		MATERIAL STANDARD:	ASTM F439 ASTM D1784 Cell Classification 23447
	TYPE:	Socket, See Note 3	
		FITTING STANDARD:	ASTM F439
		PRESSURE RATING:	150 PSI at 73°F
	TYPE:	Threaded, See Note 3	
		FITTING STANDARD:	ASTM F439
		PRESSURE RATING:	125 PSI at 73°F
	TYPE:	Van Stone Flange, See Note 3	
		FITTING STANDARD:	ASTM F441
		PRESSURE RATING:	150 PSI at 73°F
HARDWARE			
	Hardware shall be 304SST or as required to be chemically compatible with the liquid to be contained within the piping.		
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	See pipe schedule for color.		
	See Section 09 96 00 for coating requirements.		

GENERAL DESCRIPTION:	Pressure CPVC Pipe
SIZE:	½- through 8-inch nominal diameter
NOTES	
1.	Buried pipe shall be installed in accordance with ASTM F 1668 and ASTM D2774.
2.	Piping, solvent cement, solvent primer, and all other appurtenances shall be certified ANSI/NSF-61 lead free for potable water service applications.
3.	Fitting types shall be as follows, unless specifically noted otherwise: a. Socket fittings shall be provided for all buried applications. b. Threaded fittings shall be provided only where specifically indicated on the plans, or as required for connection to system components. FNPT fitting shall have external SS reinforcing band. Threaded fittings shall not be allowed for sodium hydroxide applications. c. Flanged fittings shall be provided only where necessary to connect to valves or other appurtenances in the piping system. Socket unions shall be used preferentially to Van Stone flanges.
4.	Fabricated fittings are not permitted.
5.	For chemical service: solvent welds shall use a solvent cement and primer that are compatible with the chemical being conveyed in the specific process piping. Submit product information and chemical compatibility. Contractor is ultimately responsible for ensuring chemical compatibility.
6.	Sun damaged or discolored pipe is not acceptable.

PE01

GENERAL DESCRIPTION:	Buried Small-Diameter High Density Polyethylene Pipe (HDPE)		
SIZE:	Less than or equal to 3-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	HDPE, PE 4710	
	MATERIAL STANDARD:	AWWA C901, ASTM F 714	
	SCHEDULE OR SDR:	DR 9 (minimum)	
	PRESSURE RATING OR CLASS:	250 PSI	
PIPE JOINTS			
	TYPE:	Socket Fusion Weld	
		JOINT STANDARD:	ASTM F2620
		PRESSURE RATING:	250 PSI
	TYPE:	Butt Heat Fusion Weld	
		JOINT STANDARD:	ASTM D3261
		PRESSURE RATING:	250 PSI
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS			
	MATERIAL:	HDPE	
		MATERIAL STANDARD:	ASTM D3350, ASTM D3035
	TYPE:	Socket Fusion Weld	
		FITTING STANDARD:	ASTM D2683, ASTM D3035
		PRESSURE RATING:	250 PSI
	TYPE:	Butt Heat Fusion Weld	
		FITTING STANDARD:	ASTM D3261
		PRESSURE RATING:	250 PSI
HARDWARE			
	See Paragraph 2.10 of this Specification Section.		
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	See pipe schedule for color.		
	See Section 09 96 00 for coating requirements.		
NOTES			
1.	Pipe shall conform to the outside-diameter dimensions for iron pipe size (IPS).		
2.	Brass compression couplings or pack joints with stainless steel inserts shall be provided in lieu of stainless steel where specifically noted on the Plans. Manufacturer shall be Ford, Mueller, or approved equal.		
3.	No joints, other than butt heat fusion weld joints, are allowed beneath building slabs and foundations.		
4.	Sun damaged or discolored pipe is not acceptable.		

PE02

GENERAL DESCRIPTION:	Buried Large-Diameter High Density Polyethylene Pipe (HDPE)		
SIZE:	4- through 36-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	HDPE	
	MATERIAL STANDARD:	AWWA C906, ASTM D3035, ASTM F714	
	SCHEDULE OR SDR:	DR 11 (minimum)	
	PRESSURE RATING OR CLASS:	200 psi (minimum)	
PIPE JOINTS			
	TYPE:	Butt Heat Fusion Weld	
		JOINT STANDARD:	ASTM D3261
		PRESSURE RATING:	250 PSI (DR 9); 200 PSI (DR 11)
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS			
	MATERIAL:	HDPE, PE4710	
		MATERIAL STANDARD:	ASTM 3350
	TYPE:	Butt Heat Fusion Weld	
		FITTING STANDARD:	ASTM D3261
		PRESSURE RATING:	200 PSI (DR 11)
HARDWARE			
	See Paragraph 2.10 of this Specification Section.		
NOTES			
1.	Sun damaged or discolored pipe is not acceptable.		

DI01, DI02, DI03 & DI04

GENERAL DESCRIPTION:	Ductile Iron Pipe		
SIZE:	3- through 48-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	Ductile Iron	
	MATERIAL STANDARD:	ANSI/AWWA C150/A21.50 ANSI/AWWA C151/A21.51 (mechanical, grooved, and push-on joints) ANSI/AWWA C115/A21.15 (flanged)	
	SCHEDULE OR SDR:	See Note 2	
	PRESSURE RATING OR CLASS:	350 PSI, See Note 10	
PIPE JOINTS – See Note 4			
	TYPE:	Push-on (3”-36”)	
		JOINT STANDARD:	ANSI/AWWA C111/A21.11
		PRESSURE RATING:	350 PSI
	TYPE:	Mechanical (3”-24”)	
		JOINT STANDARD:	ANSI/AWWA C110/A21.10 OR C153/A21.53
		PRESSURE RATING:	350 PSI (3”-24”)
	TYPE:	Flanged (3”- 48”)	
		JOINT STANDARD:	ANSI/AWWA C115/A21.15 ANSI B16.1
		PRESSURE RATING:	250 PSI (minimum)
	TYPE:	Grooved (3”-36”)	
		JOINT STANDARD:	AWWA C606 (3”-24” diameter), See Note 11
		PRESSURE RATING:	150 PSI (minimum)
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS – See Note 4			
	MATERIAL:	Ductile Iron	
		MATERIAL STANDARD:	ANSI/AWWA C150/A21.50 ANSI/AWWA C151/A21.51 (mechanical, grooved, and push-on joints) ANSI/AWWA C115/A21.15 (flanged)
	TYPE:	Mechanical (4”-48”)	

GENERAL DESCRIPTION:	Ductile Iron Pipe		
SIZE:	3- through 48-inch nominal diameter		
FITTINGS – See Note 4			
		FITTING STANDARD:	ANSI/AWWA C110/A21.10 OR C153/A21.53
		PRESSURE RATING:	350 PSI
	TYPE:	Flanged (3”- 48”)	
		FITTING STANDARD:	ANSI/AWWA C115/A21.15
		PRESSURE RATING:	250 PSI (minimum)
	TYPE:	Grooved (3”-36”) – See Note 9	
		FITTING STANDARD:	AWWA C606, See Note 11
		PRESSURE RATING:	150 PSI (minimum)
HARDWARE			
	See Paragraph 2.10 of this Specification Section.		
LINING (PIPE AND FITTINGS)			
DI01			
	MATERIAL:	Cement mortar	
		MATERIAL STANDARD:	ANSI/AWWA C104/A21.4
DI02			
	MATERIAL:	Epoxy	
		MATERIAL STANDARD:	See Note 6
DI03			
	MATERIAL:	Glass Lining	
		MATERIAL STANDARD:	See Note 7.
DI04			
	MATERIAL:	Unlined	
		MATERIAL STANDARD:	N/A
COATING (PIPE AND FITTINGS)			
INSTALLATION CONDITION			
	BURIED:	Exterior coated with asphaltic coating. ANSI/AWWA C151/A21.51 and ANSI/AWWA C110/A21.10 ANSI/AWWA C153/A21.53; 1 mil.	
	EMBEDDED:	See Note 1.	
	INSIDE/EXPOSED:	See Note 1.	
	SUBMERGED:	See Note 1.	
MECHANICAL RESTRAINT APPURTENANCES			
	PRODUCT:	Mechanical Joints: EBAA Iron, Inc. Series 1100 Megalug or approved equivalent. Less than or equal 16” diameter – 350 psi rating, 2:1 safety factor. Greater than 16” diameter – 250 psi rating, 2:1 safety factor. Coat with Mega-Bond liquid thermoset epoxy coating per manufacturer’s requirements.	

GENERAL DESCRIPTION:	Ductile Iron Pipe	
SIZE:	3- through 48-inch nominal diameter	
	PRODUCT:	Push-On Pipe Joints (up to 24" diameter): Field-Lok gaskets as manufactured by US Pipe, SureStop 350 gaskets as manufactured by McWane Ductile, or approved equal. Gasket shall be from the same manufacturer as the pipe.
MECHANICAL RESTRAINT APPURTENANCES		
	PRODUCT:	Grooved Joints: Victaulic Grooved Coupling Style 31, with Grade M FlushSeal gasket, and primed with phenolic alkyd primer or as required to coordinate with pipe coating system.
NOTES		
1.	See Section 09 96 00 High Performance Coatings for coating requirements. See pipe schedule for color. Reference Paragraph 2.6 for clarification on coating systems to be used for various installation locations, in particular, locations where a single spool of pipe has multiple installation conditions.	
2.	Pipe class (i.e., wall thickness) shall be as required to accommodate the required joint type, working pressure, and test pressure. Reference the Pipe Schedule for test pressure requirements.	
3.	Where taps are shown on fittings, tapping bosses shall be provided.	
4.	Unless specifically noted otherwise, the following pipe and fitting joints shall be provided at the locations indicated: a. Buried: Push-on, Mechanical, or Flanged b. Embedded: Mechanical or Flanged c. Submerged: Flanged Inside/Exposed: Flanged or Grooved	
5.	Gray-iron threaded flanges shall not be permitted.	
6.	Protecto 401 shall not be used with potable water. Provide Induron Ceramapure PL 90 lining for potable water applications requiring epoxy lining.	
7.	Glass Lining Requirements for Ductile Iron Pipe and Fittings: i. Glass-lined ductile iron pipe shall be manufactured per ASTM B1000. ii. The glass lining applied to pipe and fittings shall be vitreous material that is hard, smooth, continuous, and formulated to prevent the adherence of grease in sludge and scum lines, and to resist the adherence of crystalline metal salt deposits (Struvite and Vivionite) to sludge and centrate lines. It shall be applied to properly prepared pipe and fittings using accepted industry standards, and shall be tested per applicable standards, including ASTM D-5162-01, NACE RP 0188-99, and SSPC Coating Manual, Volume 1, Section XIV. iii. Lining shall be U.S. Pipe SG-14, Fast Fabricators/Waterworks Manufacturing MEH-32, or approved equal. iv. The applicator shall have a minimum of 5 years of successful experience in the application of high temperature glass and porcelain coatings. v. The lining material shall consist of vitreous and inorganic material applied to the internal surfaces that have been prepared by blasting. The lining shall be applied in a minimum of two (2) coats, separately applied and separately fired. The items shall be exposed to a maturing	

GENERAL DESCRIPTION:	Ductile Iron Pipe
SIZE:	3- through 48-inch nominal diameter
	temperature of approximately 1400° F, at which point the vitreous and inorganic materials melt and fuse to the base metal, forming an integral molecular bond with the base metal surface. Subsequent coatings will be in similar manner, forcing an integral molecular bond with the base coat. The entire finished coating shall be a minimum of 10 mils (.010) and a maximum of 25 mils (.025") as tested with a micro test or other acceptable dry film thickness gauge. The finished lining shall be able to withstand a strain of 0.001 inch/inch (the yield point of the base metal) without damage to the glass. vi. The lining shall have a hardness of 5-6 on the MOHS scale, and a density of 2.5-3.0 grams per cubic centimeter as measured by ASTM D-792. The glass lining shall be capable of withstanding an instantaneous thermal shock of 350° F. differential without crazing, blistering or spalling. It shall be resistant to corrosion of between PH-3 and PH-10 at 125° F. There shall be no- visible loss of surface gloss to the lining after immersing a production sample in an 8 percent sulfuric acid solution at 148° F for a period of 10 minutes. When tested according to ASTM C-283, it shall show a weight loss of not more than 3 milligrams per square inch. vii. Per ASTM D-5162-01, NACE RP 0188-99, and SSPC Coating Manual, Volume 1, Section XIV, the glass lining shall be tested by “low voltage, wet sponge, non-destructive holiday detection unit,” with only isolated voids permitted due to casting anomalies and which represent less than 0.01 percent of the total glassed surface. Test procedure and acceptance criteria shall be per the attachment “MP-9.2, Porcelain Enamel Continuity Testing,” and documentation shall be furnished with each shipment of material listing the test results by identifying "mark or “tag” numbers. viii. For flanged and grooved piping, the finished glass lined pipe shall not deviate more than 0.01875 inch per foot of length from a centerline perpendicular to the square pipe end or flange face. For bell and spigot piping, the finished glass lined pipe shall not deviate more than 0.03125 inch per foot of length from a centerline perpendicular to the square pipe end. ix. Handle pipe according to lining manufacturer’s recommendations. x. Taps and welds shall be done before lining. Field cut and repair field cuts in accordance with manufacturer’s recommendations.
8.	Pipe manufacturer shall be McWane Ductile, U.S. Pipe, or approved equal.
9.	Mechanical grooved pipe couplings and fittings, as manufactured by Victaulic Company of America or approved equivalent. Grooved pipe couplings and fittings shall conform to the following requirements. Grooved end product manufacturer to be ISO-9001 certified. Grooved flange adapter: Coupling shall be a Victaulic Style 341 grooved flange adapter or approved equivalent. The coupling shall have a ductile iron body with nitrile gaskets or orange enamel coating and 316 SS bolts and nuts.
10.	All flanged ductile iron pipe shall be rated to 250 PSI, unless specifically noted otherwise. Where required, flanged pipe with a nominal diameter less than or

GENERAL DESCRIPTION:	Ductile Iron Pipe
SIZE:	3- through 48-inch nominal diameter
	equal to 24 inches shall be rated to 350 PSI by using a specialty gasket whose rating is supported by performance testing as described by AWWA C115.
11.	Pipe barrels shall conform to the requirements of ANSI/AWWA C151/A21.51 (minimum class 53, subject to manufacturing tolerances and additional wall thickness for larger diameters, as may be required).

SST01

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe		
SIZE:	2- through 30-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	304L Stainless Steel	
	MATERIAL STANDARD:	ANSI B36.19 ASTM A312, seamless pipe	
	SCHEDULE OR SDR:	10s	
	PRESSURE RATING OR CLASS:	150 PSI (minimum)	
PIPE JOINTS – See Note 5			
	TYPE:	Butt Weld – See Note 4	
		JOINT STANDARD:	See Note 4
		PRESSURE RATING:	150 PSI (minimum)
	TYPE:	Van Stone Flange	
		JOINT STANDARD:	Class 150 or Class 300 Van Stone type flanges with stainless steel stub ends, ASTM A240 Type 316L "as-welded grade", conforming to MSS SP 43, wall thickness same as pipe.
		PRESSURE RATING:	150 PSI (minimum)
	TYPE:	Grooved	
		JOINT STANDARD:	AWWA C606
		PRESSURE RATING:	150 PSI (minimum)
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS – See Note 5			
	MATERIAL:	304L Stainless Steel, 10s	
		MATERIAL STANDARD:	ASTM A403, Grade WP304L, Class W
	TYPE:	Butt Weld – See Note 2, Note 4	
		FITTING STANDARD:	Dimension per MSS SP-43 and ANSI B16.9.
		PRESSURE RATING:	150 PSI (minimum)
	TYPE:	Grooved – See Note 3	
		FITTING STANDARD:	AWWA C606
		PRESSURE RATING:	150 PSI (minimum)
	TYPE:	Van Stone Flange	
		FITTING STANDARD:	Class 150 or Class 300 Van Stone type flanges with stainless steel stub ends, ASTM A240 Type 316L "as-welded grade",

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe		
SIZE:	2- through 30-inch nominal diameter		
			conforming to MSS SP 43, wall thickness same as pipe.
		PRESSURE RATING:	150 PSI (minimum)
FITTINGS – See Note 5			
	TYPE:	Flange	
		FITTING STANDARD:	Type: Forged stainless steel, ASTM A182, Grade F316, lap joint flange with stainless steel stub end, ASTM A240, Type 316L, welded grade conforming to MSS-SP43; schedule and size to match pipe. Faced and drilled ANSI Class 150, 1/16-inch raised face.
HARDWARE			
	See Note 8.		
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	See pipe schedule for color.		
	See Section 09 96 00 for coating requirements.		
NOTES			
1.	Pipe designated for vacuum service on the drawings shall be designed for and subject to full vacuum. Calculations showing that the selected wall thickness is acceptable for the service conditions shall be prepared and submitted. Minimum schedule 10S required.		
2.	Tees shall have no welds in the throat area and the crotch shall be reinforced with long radius design to eliminate sharp corners. Branch connections may include wrought tees or reducing tees, forged commercial welding branch fittings, extruded reducing branches, or weld-o-lets. Forged commercial welding branch fittings with butt welded outlet shall be stainless steel, in conformance with ASTM A182, Grade F316L, with schedule and material to match connected piping. No repair welding shall be performed on forged fittings without prior approval of the Engineer. Branches may be formed by an extrusion method (pulled) from pipe, where the extruded branch connections are less than 75 percent of the nominal diameter of the pipe. For extruded branch connections greater than 75 percent of the nominal diameter of the pipe, provide external reinforcing saddle strap if pipe working pressure is greater than 50 psi. Weld-o-lets may be used for connections up to 1/2-inch maximum. Construction shall match the connected pipe size, schedule, and FNPT outlet.		
3.	When used with Schedule 10S pipe, the groove shall be cut or rolled into a Schedule 40 spool piece to be welded to the pipe. The Schedule 40 spool piece		

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe
SIZE:	2- through 30-inch nominal diameter
	shall be taper bored at a 3:1 slope to provide a smooth transition of inside diameters. Machine grooves into pipe end (Schedule 40, minimum) in accordance with grooved fitting manufacturer's recommended dimensions, tolerances, and finishes. Roll cutting of grooves into piping will be permitted on minimum Schedule 40 pipe. The interior pipe wall shall be smooth and free of crevices, gouges, or other anomalies.
4.	Shop Fabricated Assemblies: • Shop fabricated assemblies shall be butt welded. • All welding shall be performed in the shop in accordance with the latest editions of Section IX of the ASME Boiler and Pressure Vessel Code and ASME Code for Pressure Piping, ASME B31.3 (normal service), as applicable. • All welds shall have 100 percent penetration. The internal weld bead shall be small, smooth and continuous with no crevices, pits or other voids. The external weld bead shall be well rounded, smooth and continuous with no anomalies. • All welded connections shall be parallel and perpendicular to the extent that the piping appears to be correct to the naked eye. • Procedure: o Pipe edges shall be prepared by machine cutting or shaping using an aluminum oxide blade. Beveled ends shall conform to the requirements of ANSI B16.9. o Clean weld joints and weld joint areas both before and after welding in accordance with ASTM A380 using stainless steel wire brushes or stainless steel wool. • Alignment: o Align ends to be joined within commercial tolerances on diameter, wall thickness, and out-of-roundness. o When joining pipes of different wall schedule, taper bore the interior of the larger schedule pipe to match the interior diameter of the connecting pipe with a maximum 1:3 slope. o Root opening at the joint shall be as stated in the procedure specification. • Welding: o The direct current, straight polarity, gas tungsten-arc (GTAW) process shall be used for all welding. Welding may be by manual GTAW or automatic (orbital) GTAW processes. o The inside of the pipe shall be purged with Argon gas during welding and while the weld is cooling to prevent oxidation of the weld. • Tack Welds: o All tack welds shall be made by a qualified welder. o All tack welds shall be made with welding rod the same as that used for the succeeding root pass. o Tack welds shall be small enough to be readily fused into the bead of the root pass.

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe
SIZE:	2- through 30-inch nominal diameter
	○ Thoroughly clean tack welds with a stainless steel wire brush prior to the root pass to prevent pinholing or excessive porosity. ○ Tack welds, which have cracked, shall be completely removed prior to making the root pass. ○ Surface defects, which will affect the soundness of the weld, shall be removed, visually inspected, and re-welded. ○ Where permitted, branch connections shall be fitted and groove-welded in accordance with the details described and shown in Chapter V of ASME B31.3.
5.	For connections requiring field assembly: • Welded: Field welding of stainless steel piping connections will not be allowed. ○ Van Stone Flanges: Flanges shall be provided preferentially for all pipe-to-pipe joints. ○ Threaded: For connections to weld-o-let outlet for instrument or sample taps only. ○ Union Fittings: Where noted or shown. ○ Flanged: For connections to flanged devices, or where otherwise noted or shown. ▪ Type: Forged stainless steel, ASTM A182, Grade F316, lap joint flange with stainless steel stub end, ASTM A240, Type 316L, welded grade conforming to MSS-SP43; schedule to match pipe. ▪ Dimensions: To match connected piping, faced and drilled ANSI Class 150, 1/16-inch raised face, unless otherwise shown or required for connection to equipment. ○ Groove Fittings: Where noted or shown. ▪ LIQUID SERVICE: • *Style: Segmented and bolted. Victaulic, Style 77; or equal* • Victaulic Style 232S restrained flexible coupling with EPDM gasket ▪ AIR SERVICE: • *Victaulic Style 232S restrained flexible coupling with silicone gaskets suitable for use with air and rated to 300°F.*
6.	CLEANING, DESCALING, PICKLING AND PASSIVATING • All stainless steel piping, fabrications, fittings and assemblies shall be shop fabricated and shall be cleaned, descaled, pickled and passivated per ASTM A380-06, ASTMA967-05 and Ferroxyl Inspected per ASTM A967-05. ○ Pickling: Process shall be by immersion method. Spray methods shall not be allowed. Fabrication size shall be constructed and coordinated with the Pickle/Passivation process such that the fabrications can be completely immersed. Contact time shall be minimum of four hours.

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe
SIZE:	2- through 30-inch nominal diameter
	○ Passivation: Rinsing must be done directly following pickling so solution does not dry. Rinsing shall use water with chloride content less than 25 mg/L. Contact with air to create passive film on the surface. Repeat pickling/passivation process if foreign material or scale has not been removed. ○ Inspection: Provide written certification that all parts have been cleaned, pickled and passivated per referenced standards. Provide Ferroxyl testing per referenced standards. ○ Shipping and Handling: Cap/seal all openings prior to shipment. Place items on clean wood surfaces and handle with non-ferrous metals for lifting and restraining during shipment. Materials shall be shipped in an enclosed trailer, and shall be stored indoors at all times.
7.	The Contractor shall provide additional non-welded joints as necessary to facilitate transportation of the pipe system components as well as construction. The Contractor is solely responsible for locating joints to avoid conflict with all other components of the Work. Contractor shall indicate all non-welded joints as part of the shop drawing submittal.
8.	Flanged Joints: Type 304 or 316 stainless steel. ASTM A193, Grade B8M hex head bolts and washers; Grade B8M hex head nuts, or equivalent. Coordinate bolt length to meet flange and device requirements. Grooved Joints: Type 316 stainless steel. Grade B-8M, Class 2; coupling manufacturer's standard size and shapes.

SST02

GENERAL DESCRIPTION:	Small-Diameter Type 304L Stainless Steel Pipe		
SIZE:	½- through 3-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	304L Stainless Steel	
	MATERIAL STANDARD:	ANSI B16.13 ASTM A312 ASTM A999	
	SCHEDULE OR SDR:	Schedule 40	
	PRESSURE RATING OR CLASS:	150 PSI	
PIPE JOINTS			
	TYPE:	Threaded	
		JOINT STANDARD:	NPT
		PRESSURE RATING:	150 PSI
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS			
	MATERIAL:	304L Stainless Steel, SCH 40	
		MATERIAL STANDARD:	ANSI B16.13 ASTM A312 ASTM A999
	TYPE:	Threaded	
		FITTING STANDARD:	NPT ANSI/MSS SP-114, ASTM A351
		PRESSURE RATING:	150 PSI
HARDWARE			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	See pipe schedule for color.		
	See Section 09 96 00 for coating requirements.		
NOTES			

GALV01

GENERAL DESCRIPTION:	Galvanized Steel Pipe		
SIZE:	Less than or equal to 4-inch nominal diameter		
PIPING MATERIAL			
	MATERIAL:	Galvanized Steel	
	MATERIAL STANDARD:	ASTM A53, Type S, Grade B	
	SCHEDULE OR SDR:	Schedule 40	
	PRESSURE RATING OR CLASS:	150 PSI	
PIPE JOINTS			
	TYPE:	Threaded	
		JOINT STANDARD:	ANSI B16.3
		PRESSURE RATING:	150 PSI
	TYPE:	Flanged	
		JOINT STANDARD:	ANSI B16.1
		PRESSURE RATING:	150 PSI
GASKETS			
	See pipe schedule for gasket material selection.		
FITTINGS			
	MATERIAL:	Galvanized Malleable Iron, Class 150	
		MATERIAL STANDARD:	ANSI B16.3
	TYPE:	Flanged	
		FITTING STANDARD:	AWWA C207, Class D (hub style, slip-on) See Note 1
		PRESSURE RATING:	150 PSI
	TYPE:	Threaded	
		JOINT STANDARD:	ANSI B16.3
		PRESSURE RATING:	150 PSI
HARDWARE			
	See Paragraph 2.10 of this Specification Section.		
LINING			
	MATERIAL:	N/A	
		MATERIAL STANDARD:	N/A
COATING			
	See pipe schedule for color.		
	See Section 09 96 00 for coating requirements.		
NOTES			
1.	Flat faced or raised face to be compatible with connecting piping, ANSI B16.1 Standard.		

APPENDIX B

Gaskets

GASKETS

SBR			
	JOINT/FITTING TYPE:	Push-On, Mechanical, and Proprietary Joints	
		MATERIAL:	Vulcanized styrene butadiene rubber (SBR).
		STANDARD:	ANSI/AWWA C111/A21.11, unless otherwise noted.
	JOINT/FITTING TYPE:	Flanged – See Note 5	
		MATERIAL:	Full faced, ⅛-inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200° F
		STANDARD:	ANSI B16.21
EPDM			
	JOINT/FITTING TYPE:	Grooved, Flanged – See Note 5	
		MATERIAL:	Full faced, ⅛-inch thick, homogeneous black rubber (EPDM), hardness 60 (Shore A), rated to 300° F
		STANDARD:	ANSI B16.21
	JOINT/FITTING TYPE:	Grooved	
		MATERIAL:	EPDM
		STANDARD:	ASTM D2000 and AWWA C606
HALOGENATED BUTYL			
	JOINT/FITTING TYPE:	Grooved	
		MATERIAL:	Halogenated butyl, Grade M
		STANDARD:	ASTM D2000 and AWWA C606
VITON (FKM)			
	JOINT/FITTING TYPE:	Flanged – See Note 5	
		MATERIAL:	Fluoroelastomer, hardness 75 (shore A) – See Note 6
		STANDARD:	ANSI B16.21
PTFE			
	JOINT/FITTING TYPE:	Flanged – See Note 5	
		MATERIAL:	Polytetrafluoroethylene
		STANDARD:	ANSI B16.21
NOTES			
1.	Gasket pressure rating to equal or exceed the system test pressure.		
2.	Blind flanges shall include a gasket which covers the entire inside face.		
3.	Gaskets shall be compatible with temperature, pressure, and service of the pipe.		
4.	Gaskets shall be the standard product of the pipe manufacturer. Alternate gaskets shall only be provided if deemed acceptable by the Engineer.		

NOTES	
5.	Flanged gaskets shall be the high performance type satisfying the special requirements of ANSI/AWWA C111/A21.11 Appendix C, Sec. C.2 and have at least three bulb type rings molded into both faces of the gasket.
6.	For use with air piping, gaskets shall be rated to 400°F and 150 psi, unless specifically noted otherwise.

APPENDIX C

Couplings

COUPLINGS

TYPE 1		
	GENERAL DESCRIPTION:	Straight and Transition, between dissimilar or the same pipe material, buried installations
	USE WITH:	Steel, C900 PVC, and Ductile Iron
	SIZE:	2”- 24” nominal diameter, see Note 1
	PRESSURE RATING:	260 PSI
	MATERIAL:	Ductile iron, ASTM A536
	LINING:	Fusion bonded epoxy coating, AWWA C213
	COATING:	Fusion bonded epoxy coating, AWWA C213
	GASKET:	SBR ASTM D2000 MBA 710 unless specifically noted otherwise
	PRODUCT:	Romac Industries Style 501 or approved equivalent
	NOTES:	1. If coupling is located within the minimum restrained length, or where specifically noted on the Plans, provide external restraint harness Romac Series 600 (12-inch and smaller for ductile iron, 14-inch and larger for C900 PVC) to provide longitudinal restraint with vertical joint flexibility. Thrust blocks shall only be provided where specifically shown on the plans or where deemed acceptable by the Engineer. 2. Minimum sleeve length shall be 5” for 2”-18” nominal pipe size and 7” for >18” nominal pipe size.
TYPE 2		
	GENERAL DESCRIPTION:	Straight, restrained, between the same pipe material, buried installations
	USE WITH:	Ductile iron, steel, and C900 PVC
	SIZE:	12”- 48” (ductile iron), 12” (steel), and 12”-24” (C900 PVC)
	PRESSURE RATING:	12”-16” ductile iron: 350 PSI 18”-24” ductile iron: 250 PSI 30”-48” ductile iron: 150 PSI PVC: 150 PSI
	MATERIAL:	Body: beveled, flared, or formed carbon steel, AWWA C219
	LINING:	Fusion bonded epoxy coating, AWWA C213
	COATING:	Fusion bonded epoxy coating, AWWA C213
	GASKET:	14-24”: standard MJ gasket per ANSI/AWWA C111/A21.11 12” and 30”-48”: SBR ASTM D2000
	PRODUCT:	Romac FC400RG, or approved equivalent

	NOTES:	1. Provide Romac RomaGrip or mechanical joint retainer glands as required by the manufacturer. 2. Provide 7/8-9 roll thread, ductile iron restraining bolts per ASTM A536. 3. Provide heat-treated ductile iron restraining lugs per ASTM A536. 4. Provide 304 stainless steel nuts and bolts.
TYPE 3		
	GENERAL DESCRIPTION:	Reducing Coupling, buried installations
	USE WITH:	C900 PVC, Steel, Ductile Iron connections with reduction in size/change in materials, unrestrained
	SIZE:	14”- 48”
	PRESSURE RATING:	150 PSI
	MATERIAL:	Beveled, flared, or formed carbon steel with minimum yield of 30,000 PSI
	LINING:	Fusion bonded epoxy coating, AWWA C213
	COATING:	Fusion bonded epoxy coating, AWWA C213
	GASKET:	Nitrile Butadiene Rubber (NBR), AWWA C219 and ASTM D20000
	PRODUCT:	Romac Industries Style RC400 or approved equivalent
	NOTES:	1. Provide trackhead bolts, heavy hex nuts, 5/8” UNC rolled thread, high strength, low alloy corrosion-resistant steel per AWWA C111. Threads shall be protected with plastic caps on each bolt end.
TYPE 4		
	GENERAL DESCRIPTION:	Field Flange Adapter, exposed installations
	USE WITH:	Ductile Iron and Steel Pipe tested in accordance with AWWA C600 or ASTM D2774 and conforming to ANSI/AWWA C151/A21.51
	SIZE:	3” – 12”
	PRESSURE RATING:	3”-8”: 250 PSI 10”-12”: 200 PSI
	MATERIAL:	Ductile Iron, ASTM A536 Flanges: ANSI/AWWA C110/A21.10
	LINING:	Manufacturer’s standard high build epoxy, MEGA-BOND by EBAA Iron Inc. or approved equivalent.
	COATING:	Manufacturer’s standard high build epoxy, MEGA-BOND by EBAA Iron Inc. or approved equivalent.
	GASKET:	EBAA E-Z Flange Gasket (ductile iron pipe); Transition gasket as required by the manufacturer (steel pipe)
	PRODUCT:	EBAA Iron, Inc. Series 1000 E-Z Flange, or approved equivalent

	NOTES:	1. For interior/exposed applications only. Not for use on buried applications.
TYPE 5		
	GENERAL DESCRIPTION:	Restrained Flange Adapter, buried installation
	USE WITH:	Ductile iron, C900 PVC, steel, and HDPE Ductile Iron and Steel Pipe tested in accordance with AWWA C600, AWWA C605, or ASTM D2774
	SIZE:	3”-24” (ductile iron and PVC) 3”-12” (steel and HDPE) 30”-48” (ductile iron)
	PRESSURE RATING:	3”-16” ductile iron: 350 PSI 18”-24” ductile iron: 200 PSI minimum 30”-48” ductile iron: 150 PSI 4”-20” DR18 C900 PVC: 235 PSI 24” DR18 C900 PVC: 150 PSI 4”-24” DR25 C900 PVC: 165 PSI 3”-12” steel: 350 PSI 3”-12” DR11 HDPE: 160 PSI
	MATERIAL:	Ductile Iron, ASTM A536 Flanges: ANSI/AWWA C111/A21.11 with flange surface facing in accordance with ANSI/AWWA C207. ANSI B16.5 Class 150/125 drilling pattern.
	LINING:	Wetted parts: fusion bonded epoxy per ANSI/AWWA C213 External parts: fusion bonded epoxy per ANSI/AWWA C116/A21.16 Restraint Ring: Manufacturer’s standard high build epoxy, MEGA-BOND by EBAA Iron Inc. or approved equivalent.
	COATING:	Manufacturer’s standard high build epoxy, MEGA-BOND by EBAA Iron Inc. or approved equivalent.
	GASKET:	Provide transition gaskets where required by the manufacturer.
	PRODUCT:	EBAA Iron, Inc. Series 2100 MEGAFLANGE, or approved equivalent.
	NOTES:	1. Provide stainless steel hardware. 2. For buried installation only. 3. Set screw type grips are not acceptable.
TYPE 6		
	GENERAL DESCRIPTION:	Flanged Dismantling Joint, buried installations
	USE WITH:	Ductile iron, steel, PVC
	SIZE:	3”-48”
	PRESSURE RATING:	3”-12”: 175 PSI 14”-48”: 150 PSI
	MATERIAL:	Flanged Spool: AWWA Class D ring flange, compatible with ANSI Class 125 or 150 bolt

		circles. SCH 40 ASTM A53 (3”-12”); ASTM A36 carbon steel (14”-48”) End Ring and Body: ductile iron ASTM A536 (3”-12”); carbon steel ASTM A36 with AWWA C207 Class D flanges. Hardware: 304 SST Tie Rods: 304 SST, ASTM A193 gr B8 or B8M
	LINING:	Fusion bonded epoxy coating
	COATING:	Fusion bonded epoxy coating
	GASKET:	Water/sewer Service: NBR ASTM D2000 MBA810Z Air Service: Provide EPDM peroxide cured gasket when used with aeration piping (ALP or AHP). Gasket shall be suitable for use with temperatures up to 250°F.
	PRODUCT:	Romac Industries, Inc. Style DJ400 or approved equivalent
	NOTES:	N/A
TYPE 7		
	GENERAL DESCRIPTION:	Stainless Steel Pipe Couplings, interior/exposed installations
	USE WITH:	Steel, stainless steel
	SIZE:	3”-48”
	PRESSURE RATING:	Pressure rating shall be 1.5 times working pressure, unless specifically noted otherwise.
	MATERIAL:	316 SST or Carbon Steel, see Note 3
	LINING:	Fusion bonded epoxy (for carbon steel)
	COATING:	Fusion bonded epoxy (for carbon steel)
	GASKET:	Match pipe system gasket selection
	PRODUCT:	AWWA C227 Straub Flex Coupling or approved equivalent
	NOTES:	1. Coupling shall meet all applicable AWWA and NSF requirements. 2. Provide Romac AWWA M-11 harness restraint system, or approved equivalent, where external restraint or anchoring is not otherwise provided. 3. Galvanized components are not acceptable. 4. Provide stiffening ring as required by the manufacturer.
TYPE 8		
	GENERAL DESCRIPTION:	Mechanical Joint Adaptor, buried installations
	USE WITH:	Ductile iron pipe direct connections between MJ fittings and valves
	SIZE:	3”-36”

	PRESSURE RATING:	350 PSI (3”-24”) 250 PSI (30”-36”)
	MATERIAL:	Ductile Iron
	LINING:	Protecto 401 Epoxy
	COATING:	Epoxy
	GASKET:	N/A
	PRODUCT:	Foster Adaptor
	NOTES:	1. Provide stainless steel hardware

FLEXIBLE COUPLINGS

Type 20		
	GENERAL DESCRIPTION:	Single Sphere Flexible Coupling, interior/exposed installations
	USE WITH:	Flanged wastewater service pipe systems to accommodate axial compression and extension, lateral deflection, angular movement, and vibration
	SIZE:	4”-30”
	PRESSURE RATING:	See Note 1
	TEMPERATURE RATING:	265°F
	MATERIAL:	Elastomer (cover and tube): EPDM Flanges: 304 SST, freely rotating on the bellows
	LINING:	N/A
	COATING:	N/A
	GASKET:	N/A
	PRODUCT:	Proco Style 240 single sphere, or approved equivalent
	NOTES:	1. Pressure rating at the anticipated operating temperature shall be equivalent to the test pressure for the associated pipe system. Reference the Pipe Schedule for additional information. 2. Provide external limit/control rods to limit fitting expansion and contraction. 3. Rods and hardware shall be SST. 4. Couplings shall be installed within manufacturer's recommended piping misalignment limits. Expansion couplings shall not be used to correct pipe misalignment. 5. Pipe systems shall be fully supported either

		side of the flexible coupling. 6. Do not position against check or isolation valves.
Type 21		
	GENERAL DESCRIPTION:	Bellows Connector Expansion Joint, interior/exposed installations
	USE WITH:	For use with digester gas piping
	SIZE:	2”-12”
	PRESSURE RATING:	225 PSI at 150°F 110 PSI at 480°F
	TEMPERATURE RATING:	480°F
	MATERIAL:	All wetted parts: Stainless Steel Vanstone Flange: Carbon Steel ANSI 150#
	LINING:	N/A
	COATING:	N/A
	GASKET:	Neoprene Grommet
	PRODUCT:	Flexicraft Industries, Bellows Connector Expansion Joint, or approved equivalent
	NOTES:	1. Joints are to be provided with stainless steel drop-in liners and carbon steel covers. 2. Tie rods shall be included to prevent overextension of the expansion joints from pressure thrust loads. The number and size of the control rods shall be sufficient for the maximum system test pressure.
Type 22		
	GENERAL DESCRIPTION:	Reducing Expansion Joints, interior/exposed installations. See Note 1
	USE WITH:	Flanged wastewater service pipe systems to accommodate axial compression and extension, lateral deflection, angular movement, and vibration
	SIZE:	2”x1” to 18”x16”
	PRESSURE RATING:	See Note 2
	TEMPERATURE RATING:	250°F

	MATERIAL:	Elastomer (cover and tube): EPDM
	LINING:	N/A
	COATING:	N/A
	GASKET:	N/A
	PRODUCT:	Proco Style RE-231 (eccentric single wide-arch expansion joint), Proco Style RC-231 (concentric singe wide-arch expansion joint), or approved equal
	NOTES:	1. Provide eccentric or concentric expansion joint as denoted on the Plans. 2. Pressure rating at the anticipated operating temperature shall be equivalent to the test pressure for the associated pipe system. Reference the Pipe Schedule for additional information. 3. Provide external limit/control rods to limit fitting expansion and contraction. 4. Rods and hardware shall be SST. 5. Couplings shall be installed within manufacturer's recommended piping misalignment limits. 6. Pipe systems shall be fully supported either side of the flexible coupling. 7. Do not position against check or isolation valves.
Type 23		
	GENERAL DESCRIPTION:	Chemical Service Flexible Coupling, interior/exposed installations
	USE WITH:	Chemical service, PVC pipe system applications
	SIZE:	1.5"-36"
	PRESSURE RATING:	1.5"-6": 225 PSI 8"-12": 210 PSI 14"-20": 150 PSI 24"-36": 100 PSI (minimum)

	TEMPERATURE RATING:	250°F
	MATERIAL:	Cover: EPDM
	LINING:	PTFE
	COATING:	N/A
	GASKET:	N/A
	PRODUCT:	Proco Series 231/ET PTFE expansion joint, or approved equal
	NOTES:	1. Provide external limit/control rods to limit fitting expansion and contraction. 2. Rods and hardware shall be SST. 3. Couplings shall be installed within manufacturer's recommended piping misalignment limits. Expansion couplings shall not be used to correct pipe misalignment. 4. Pipe systems shall be fully supported either side of the flexible coupling. 5. Do not position against check or isolation valves.

QUICK CONNECT COUPLINGS

Type 40		
	GENERAL DESCRIPTION:	Twin cam arm actuated, male and female, locking
	USE WITH:	Chemical Systems
	SIZE:	½”-4”
	PRESSURE RATING:	See Note 1
	TEMPERATURE RATING:	200°F
	MATERIAL:	Glass-filled polypropylene or PVDF with EPDM
	LINING:	N/A
	COATING:	N/A
	GASKET:	Viton-A or Teflon gaskets as recommended for the chemical service by the manufacturer
	PRODUCT:	BANJO, Qianli, or approved equivalent
	NOTES:	1. Pressure rating at the anticipated operating temperature shall be equivalent to the test pressure for the associated pipe system. Reference the Pipe Schedule for additional information. 2. End Connections: NPT threaded or flanged to match piping connections. Hose shank for chemical installations. 3. Plugs and Caps: Female dust cap for each male end; male dust plug for each female end.
Type 41		
	GENERAL DESCRIPTION:	Twin cam arm actuated, male and female, locking
	USE WITH:	Sewage service
	SIZE:	½”-4”
	PRESSURE RATING:	150 PSI (minimum)
	TEMPERATURE RATING:	380°F (maximum)
	MATERIAL:	Stainless steel
	LINING:	N/A
	COATING:	N/A
	GASKET:	Buna N gaskets as recommended for the service by the manufacturer.

	PRODUCT:	OPW Kamlok or approved equal
	NOTES:	1. End Connections: NPT threaded or flanged to match piping connections. Hose shank quick connect coupler. 2. Plugs and Caps: Female dust cap for each male end; male dust plug for each female end.

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SECTION 40 90 00

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the furnishing and installation of metering and control equipment which shall include the following principal items:
   1. Metering and Control Systems. Principal components of the metering and control systems shall be as listed on the "Instrument List" at the end of this section and shall include the PLC system as is shown on the Drawings.
   2. Miscellaneous. One lot of test equipment, spare parts, and miscellaneous devices as set forth herein. Supplementing this section, the drawings indicate locations and arrangement of panels and instruments and provide functional diagrams and schematics regarding connection and interaction with other equipment.

B. Related Sections
   1. Division 01 – Materials and Equipment
   2. Section 26 00 00 – Electrical

1.2 REFERENCES

A. Codes & Permits
   1. All work and materials shall comply with the National Electrical Code, the National Electrical Safety Code, and applicable local regulations and ordinances. All panels shall be listed by Underwriters Laboratories or other testing organizations acceptable to the governing authority. The Contractor shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in local jurisdiction of such work.

1.3 SUBMITTALS

A. Complete fabrication, assembly, and installation drawings: wiring and schematic diagrams: and details, specifications, and data covering the materials used and the parts, devices, and accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. Submittal data shall be grouped and submitted in two separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Instrument tag numbers indicated on the contract drawings shall be referenced where applicable. Submittal data for multifunctional instruments shall include complete descriptions of the intended functions and configurations of the instruments.
   1. First-stage Submittal. The first-stage submittal shall include the following items.
      a. Product catalog cut sheets clearly marked to show the applicable model number, operational features, and intended service of the device.
      b. A detailed list of any exceptions, functional differences, or discrepancies between the Supplier's proposed system and the contract requirements.

c. Complete panel fabrication drawings and details of panel wiring, piping, and painting. Panel and subpanel drawings shall include overall dimensions, metal thickness, door swing, mounting details, and front of panel arrangement to show general appearance, with spacing and mounting height of instruments and control devices.
d. System wiring and installation drawings for all interconnecting wiring between components of the systems furnished and for all interconnecting wiring between the related equipment and the equipment furnished under this section. Wiring diagrams shall show complete circuits and indicate all connections.
e. If panel terminal designations, interdevice connections, device features and options, or other features are modified as a result of the fabrication process or factory testing, revised drawings shall be resubmitted.
f. A total of seven (7) copies for the submittal shall be provided.

2. Second-stage Submittal. Complete system documentation, in the form of operation and maintenance manuals, shall be provided. Manuals shall include complete product instruction books for each item of equipment furnished.
   a. Where instruction booklets cover more than one specific model or range of instrument, product data sheets shall be included which indicate the instrument model number, calibrated range, and all other special features. A complete set of "as-built" wiring, fabrication, and interconnection drawings, calibration and startup sheets shall be included with the manuals.
   b. A copy of all final O&M manuals shall be provided in PDF format on a USB Thumb drive. All AutoCAD drawings shall be provided in PDF and DWG formats.
   c. A total of two (2) printed copies, and two (2) softcopies of final O&M manuals shall be provided.

1.4 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be designed, coordinated, and supplied by a qualified system integrator (Integrator) who is regularly engaged in the business of designing and building instrument and control systems for water and wastewater projects. The Contractor's intended Integrator shall meet the following qualifications.
      a. The Integrator shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
      b. The Integrator shall have the physical plant and fabricating personnel to complete the work specified. The Integrator's fabrication capabilities and arrangements shall be acceptable to the Engineer.
      c. The Integrator shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
      d. The Integrator shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

B. Coordination.

1. Instrument and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All instruments and control devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufactured and the manufacturer of related equipment.
2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
3. The Integrator shall provide coordination with other contractors and supervision of installation as required during construction.
4. Coordination shall be provided between the Integrator and the process system supplier.
5. Instrument and control systems shall be designed and coordinated for proper operation with other sections of these specifications. These shall include but not be limited to Materials and Equipment – Division 01, Electrical – Section 26 00 00, Programmable Logic Controllers – Section 40 95 00.

1.5 WARRANTY

A. All suppliers shall warrant their hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
   1. Power and Instrument Signals. Unless specified otherwise, electrical power supply to the instrumentation equipment will be unregulated 120 VAC at the locations noted on the one-line and functional diagrams. All transmitted electronic analog instrument signals shall be 4-20 mA DC and shall be linear with the measured variable.
   2. Metering Accuracy. System metering accuracy, as compared to the actual process value, shall be determined from the value read at the principal readout device such as the recorder or totalizer. System requirements shall not preclude any requirements specified herein for individual devices.
      a. For systems where the primary measuring device, transmitter, and receiver are furnished under this section, the accuracies shall be within the following limits:
         i) Level: 1.0% of measured span.
         ii) Flow Rate: magnetic or transit time ultrasonic metering: 0.5% of full scale between 1.0 and 100% of scale.

3. Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation requirements shall be furnished and installed as required for proper performance of the equipment.
4. Interchangeability and Appearance. Instruments used for the same types of functions and services shall be of the same brand and model line insofar as possible. Similar components of different instruments shall be from the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished. Recorders, process indicators, control stations, and similar panel-mounted instruments shall be of the same style and shall be products of the same major instrument manufacturer.
5. Programming Devices. A programming or system configuring device shall be provided for systems that contain any equipment which required such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete and in like-new condition and shall be turned over to the Owner at completion of the startup.
6. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the instrument device schedules and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanels, and rack-mounted devices shall have laminated plastic identification tags securely fastened to the device. Hand lettered labels or tape labels will not be acceptable.
7. Special Tools and Accessories. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.
8. Provide sunshade for outdoor installations.
9. Provide stainless steel tags for each instrument.

2.2 PANEL FABRICATION

A. General Fabrication Requirements. All panels furnished hereunder shall conform to the requirements of NEMA ICS-6-1988. The following paragraphs describe general fabrication requirements for the instrument panels, consoles, enclosures, and subpanels:
   1. All completed panels shall be UL 508A or UL 698 listed (as appropriate).
   2. Wiring.
      a. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded tinned copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90°C.
      b. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 VAC. Surge protectors shall be of a non-faulting and non-interrupting design, with a response time of not more than 5 nanoseconds. Surge protectors shall be Cutler Hammer AEGISPowerline Filters, or equal.
      c. Panels that are over 15 cubic feet in total volume shall have panel lighting above each door of the panel.

d. Power distribution wiring on the line side of the panel's protective devices shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 16 AWG. Wiring for control circuits shall be minimum 16 AWG. Electronic analog circuits shall be 18 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color coding legend on the system supplier's panel wiring diagrams.
e. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with a marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 20% spare terminals shall be provided. Each control loop or system shall be individually fused, and all fused or circuit breakers shall be clearly labeled and located for easy maintenance. Terminal block shall be Phoenix Contact UT 4-MTD series.
f. All wiring shall be grouped and firmly supported inside the panel. Wiring shall be routed in nonmetallic slotted wire duct or similar. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40% of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables. Wire duct shall be Thomas & Betts Ty Duct or approved equal.
g. Where signal or loop wiring must be routed to more than one panel or device, the required circuit routing shall be as indicated on the one-line diagrams.
h. All analog input signals coming from external from the building where the panel is located shall have surge protection.
i. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.
j. All wires in the panel shall be identified at both ends of the wire. These labels shall agree with the labels shown on the wiring diagrams. The wire labels shall be of the heat-shrink tube type of wire marker as manufactured by Brady thermal labels.
k. All instruments that require 120vac power that have the signal from the instrument going to a panel, shall be provided 120vac from that panel. The 120vac circuit to these instruments shall be individually fused.

3. Uninterruptable Power Supply (UPS)
   a. Any panels that have PLCs or are shown to have a UPS on the drawings shall have a UPS.
   b. The PLC and all associated equipment shall be powered by a UPS.
   c. The UPS shall be sized to provide power to all devices connected to it for a minimum of 30 minutes.
4. The UPS shall be wired so that in the event of the UPS failure, the PLC panel will be powered by utility power and an alarm will be generated.
5. Nameplates. Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions

and legends, as indicated on the drawings, letters approximately 3/16 inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the requirement for device identification tags as specified herein under the Device Tag Numbering System paragraph.

6. Painting. Interior and exterior surfaces of all panels shall be thoroughly cleaned and painted with rust-inhibitive primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils.
7. Factory test. Panels shall be factory tested electrically by the panel fabricator before shipment.

2.3 METERING & CONTROL SYSTEMS

A. Principal components for the metering and control systems are indicted on the "Instrument List" at the end of this specification.

2.4 CONTROL COMPONENTS

A. Panel Front-Mounted Devices
   1. SELECTOR SWITCHES. Selector switches shall be a minimum 30 mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 volts ac. Contact configuration shall be as indicated on the drawings or as required for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Eaton "Series 10250T", Square D "Class 9001", or approved equal.
   2. PUSH BUTTONS. Push buttons shall be a minimum 30 mm, heavy-duty, oil-tight type. Legends shall be engraved on push button faceplate. Contacts shall be rated 10 amperes continuous at 120 VAC. Push buttons shall be Eaton "Series 10250T", Square D "Class 9001", or approved equal.

B. Panel Interior-Mounted Devices
   1. POWER SUPPLIES. Regulated DC power supplies for instrument loops shall be provided as needed. Power supplies shall be suitable for input voltage variation of plus or minus 10%. The DC power supplies shall be Idec "PS5R Slim line", or Phoenix Contact "UNO".
   2. RELAYS. Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be UL listed. Relays shall have a minimum rating of 10 amperes at 120 VAC. Time-delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of +/- 2.0% of setting. Latching and special purpose relays shall be as required for the specific application. Relays shall have a light to indicate when coil is energized. Relays shall be Idec "RH or RTE Series" or approved equal.

3. AUTODIALER. Autodialer shall be 120 VAC powered and have a minimum of 8 discrete inputs, 3 discrete outputs, 2 analog inputs. Discrete inputs shall be dry digital inputs with selectable wire fault supervision or direct attach current sensing switches. Discrete outputs shall be dry contact relay outputs and rated at 5A at 30VDC SPDT N/O, N/C. Analog inputs shall be 4-20mA isolated with 4 alarms set points per signal. The device shall be equipped with 12V back up battery power. Enclosure shall be NEMA 4X if located exterior of environmentally controlled or in a hazardous area. The device shall be capable of cellular communication or omnidirectional radio communications for optional SCADA integration OPC link to client/server HMI. Autodialer I/O list shall be located in Section 3.4. Autodialer shall be RACO Catalyst, SCADA link Protalk or approved equal.

2.5 INSTRUMENTATION

A. Flow Instrumentation
   1. Magnetic Flow Meters
      a. The Magnetic Flow Meter shall be a completely obstruction less, in-line flow meter with no constrictions in the flow of fluid through the meter. The meter shall consist of a metallic tube with flanged ends and with grounding rings. Flange diameter and bolt drilling pattern shall comply with ANSI/ASME B16.5, Class 150 for 24" and smaller, and AWWA Class D for 28" and larger. Meters shall be suitable for the maximum range of working pressures of the adjacent piping. Electrode and liner materials shall be fully compatible with the process fluid and shall comply with the requirements specified in the instrument device schedules. Each meter shall be factory calibrated, and a copy of the calibration report shall be submitted as part of the operation and maintenance manual submittal.
      b. In vaults, wet wells and all other below grade locations the flow meter shall be IP68/NEMA 6P Protection.
      c. The meter shall be capable of standing empty for extended periods of time without damage to any components. The meter housing shall be of a splash-proof and drip-proof design.
      d. Power supply to the meter shall be 120 VAC, 60 Hz, single phase.
      e. Provide NSF61 Drinking Water approval for Water Applications.
      f. Meters shall be Endress+Hauser Promag W 400 or approved equal.

B. Pressure and Level Instrumentation

   1. Gauge Pressure Transmitters.
      a. Transmitters used to measure process pressure or inferred level from process pressure such as a bubbler system or other source, shall include diaphragm type piezo resistive pressure transducer and microprocessor-based electronics. Transmitters shall be 24VDC loop power. Transmitters shall have self-diagnostics and electronically adjustable span, zero, and damping.
      b. Transmitters shall be enclosed in a NEMA Type 4X housing and shall be suitable for operation at temperatures from 0 to 180ºF. All transmitter parts shall be of a corrosion-resistant material.
      c. Vents shall be provided on the sides of the diaphragm housing body. Transmitter shall have over-range protection to 1.5 times the upper range limit.

d. Accuracy shall be plus or minus 0.5% of calibrated span, with repeatability of 0.1%.
e. Transmitter output shall be 4-20mA DC without the need for external load adjustments and shall have an elevated or suppressed zero as required by the application.
f. Display shall be integrally mounted 2-Line LCD display scaled with engineering units.
g. Each transmitter shall be provided with a process shutoff valve and a bracket for mounting as required.
Bluetooth Enabled
h. Transmitters shall be Endress+Hauser "Model PMP51" or, approved equal.

2. Radar Level Transmitters
a. The transducer shall emit radar pulses via the transmitter, with a frequency range of 6.3 GHz to 26 GHz. The instrument measures the pulse travel time between transmitter, surface, and receiver to calculate the level. The antenna design shall be suitable for mounting in nozzle as indicated on drawings. The design shall be such that product condensation on the antenna shall not affect the performance. Able to ignore momentary level spikes or momentary loss of echo and indicate loss of echo condition. Must be able to measure up to 98FT. Shall operate in process temperatures -40 to 176ºF. Wetted parts shall be chemically compatible with process. Must have microprocessor-based signal transmitter. Power supply will be 4-wire 24VDC. Output signal shall be 4-20mA. Transmitter shall have backlit LCD display which can be remotely mounted if necessary. Transmitter shall be housed in NEMA 4X enclosure.
b. Secure and encrypted Bluetooth wireless technology for commissioning, operation, and maintenance via iOS/Android app.
c. The Radar level transmitter shall be Endress+Hauser "Micropilot M FMR20", or approved equal.

3. Weighted Float Level Switches
a. Each level switch shall consist of a single-pole, double-throw switch, rated not less than 3 amperes AC, sealed, and housed in a chemical-resistant polypropylene casing. The switch assembly shall be weighted and suspended on its own cable. The flexible support cable shall be waterproof, three-conductor, synthetic covered cable with 18AWG conductors, and shall be of sufficient length so that no splice or junction box is required in the wet well. Switches shall be suitable for operation up to 150 volts within an ambient temperature range of 32° to 140°F. Switches shall be suitable for use in a sanitary or wastewater wet well environment. Mercury switches are not acceptable. Installation hardware shall be provided as shown on the drawings or as necessary for application.
b. Switches shall be Flygt "Type EMN-10", MJK "7030", Conery "2902 Series B6", or approved equal.

4. Conductance Relay Level Switch
a. Each level switch shall consist of a single-pole, double-throw relay with contacts rated not less than 5 amperes ac at 120 VAC. The relay primary power shall be 120 VAC. The electrodes shall be flexible wire suspension type with shielded

stainless steel electrode tips. The electrode holder shall be the manufacturer's standard holder appropriate for the application.

b. Electrodes and conductance relay shall be as manufactured by Gems Sensors (Warrick Controls) or Ametek (BW Controls), or approved equal.
c. Plus model 1279XLL", Ametek US Gauge 1553, or approved equal.

C. Analytical Instruments
1. PH Level
a. The pH sensor shall be encapsulated sensor with digital signal processor, preamplifier, reference electrode, measuring electrode, ground electrode, and replaceable salt bridge.
b. The probe has a built in Pt 1000 RTD temperature compensator.
c. Measurement Range: 0 to 14 pH.
d. Sensor shall have wetted material of PEEK® or Ryton®. Sensor shall have 1-inch NPT threads on both ends.
e. Manufacture cable to be provided. Cable distance shall be field verified.
f. Provide microprocessor-based electronics capable of monitoring 2 sensors and providing an individual linear 4-20mA signal to the PLC for each sensor.
g. The unit shall provide 0-14pH, -2000 - +2000mV measuring range with a sensitivity of less than 0.005pH. The operating temperature range shall be between -5 -95*C.
h. Power Supply shall be 100-240 VAC.
i. Provide backlit LCD Display
j. Analyzer shall be provided with all parts and accessories for a complete and operational system
k. Hach system: Analyzer transmitter shall be a Hach "SC4500" and the sensor shall be a Hach pHD SC Digital Differential with temperature signal capability, YSI system: transmitter shall be "YSI 470026Y / MIQ / TC 2020 3G-MC3 and the Analyzer junction box shall be a "YSI 48000Y/ MIQ/JB", and the probe shall be "YSI 109115Y/ SensoLyt SEA", or E&H System.

2. H2S Gas Level
a. Device shall have Bluetooth capabilities.
b. Device shall be portable and battery powered.
c. Transmitter shall output4-20mA signal with HART protocol communications.
d. Detector shall be Class 1, Div. 1 certified. Gasses to be detected shall be provided by Authority Having Jurisdiction but are typically methane (CH4), Hydrogen Sulfide (H2S), and Oxygen (O2).
e. Provide calibration kit in carrying case including appropriate gas with all necessary hardware.
f. Acceptable package system shall be Acrulog IPX or approved equal.

D. Miscellaneous Instrumentation
1. Magnetic Door Switch
a. The magnetic door switch shall be a two-piece switch rated 100V AC/DC.
i) Mandoor use: Switch shall be Edwards 60 Series or approved equal.
ii) Overhead Door use: Switch shall be Edwards 2200 Series or approved equal.

2. Temperature Switch
a. Temperature switches shall be constructed with an all-metal case. Switches shall have contacts rated 10A at 120 VAC.

b. Switches shall be Dayton Model 1UHH1 or approved equal.
c. equal.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
1. The instrumentation equipment shall be installed by the Contractor or his subcontractors in accordance with the manufacturers' instructions. The services of the system Supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation.

B. Inspection.
1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
   a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation.
1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
   a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
   b. Perform all work in accordance with manufacturer's instructions.
      i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
      ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
   c. Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.
   d. Field Piping. Field piping materials and installation shall conform to the requirements of the miscellaneous piping section.
   e. Field-Mounted Instruments. Instruments shall be mounted so they may be easily read and serviced and all appurtenant devices are easily operated. Installation details for some instruments are indicated on the drawings. Unless otherwise indicated on the drawings, instruments which include local indicators shall be mounted approximately 5 feet above the floor and shall be oriented for ease of viewing. Transmitters shall be mounted on corrosion-resistant pipe supports suitable for floor, wall, or bracket mounting.

D. Field Calibration. A technical representative of the system supplier shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final tuning adjustment settings. The adjustment of each calibrated

instrument shall be sealed or marked, insofar as possible, to discourage tampering. Instruments shall be calibrated before checkout of the operation of the system.

E. Systems Check. A technical representative of the system supplier shall participate in the checkout of metering and control systems. If interrelated devices furnished by other suppliers, such as valve actuators, motor controls, chemical feeders, or primary measuring devices, do not perform properly when placed in service, the technical representative shall use suitable test equipment to introduce simulated signals to verify or measure signals from such devices as required to locate the source of trouble or malfunction. A written report stating the results of such tests shall be furnished, if requested by the Engineer, to assign responsibility for corrective measures.
   1. Installation Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by the Contractor for the duration of the testing work. Unless specified otherwise, test equipment will remain the property of the Contractor or the system Supplier.

F. Adjustment and Cleaning
   1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
   2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

3.2 CUSTOMER TRAINING

A. The coordinating supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training session shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of one 4-hour session, and the schedule shall be arranged and coordinated with the Engineer.

3.3 INSTRUMENT LIST

Palisade Sewer Transfer Lift Station
Instrument List

Tag #	Description	Service	Scale	Notes / Provided by
LS-LSH-1000	Pump Station Water on Floor	Conductance relay switch		
LS-TSL-1000	Pump Station Low Temperature	Temperature Switch		
LS-ZS-1000	Pump Station Door Intrusion	Magnetic Door Switch		
LS-LSH-1100	Wet Well Level Switch High	Weighted Float		
LS-LSL-1100	Wet Well Level Switch Low	Weighted Float		
LS-LIT-1100	Wet Well Level	Radar Level Transmitter		
LS-AIT-1100	Wet Well Instrument Controller	Hach SC4500		
LS-AE-1100	Wet Well pH/Temp	pH Level		
LS-FE/FIT-1101	Transfer Station Flow	Magnetic Flow Meter		

LS-PIT-1102	Force Main Pressure	Pressure Transmitter		
LS-AE-1103	Wet Wel/ Force main H2S	H2S Gas Level		To be battery powered, no connection to SCADA

3.4 AUTODIALER I/O LIST

Palisade Sewer Transfer Lift Station
Autodialer I/O List

Tag #	Description	Address	DI	DO	AI	AO	Scale	Notes
LS-JA-1000	Utility Power Fail		1				120VAC	
LS-JA-1001	UPS Power Fail		1				120VAC	
LS-LAH-1002	Transfer Station Water on Floor Alarm		1				120VAC	
LS-TAL-1003	Transfer Station Low Temperature Alarm		1				120VAC	
LS-ZA-1004	Transfer Station Intrusion Alarm		1				120VAC	
LS-XA-1020	Odor Control General Fault		1				120VAC	
LS-LAH-1100	Wet Well Level Switch High		1				120VAC	
LS-LAL-1100	Wet Well Level Switch Low		1				120VAC	
LS-XA-1110	Pump #1 General Fault		1				120VAC	
LS-XA-1120	Pump #2 General Fault		1				120VAC	
	Totals		10	0	0	0		

END OF SECTION

SECTION 40 95 00

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes the items listed below and all other components necessary for a complete system as noted herein and indicated on the drawings
   1. Programmable Logic Controllers (PLCs)
   2. Communication equipment
   3. HMI software
   4. Programming
   5. Spare parts

B. Related Sections
   1. Division 01 – Materials and Equipment
   2. Section 26 00 00 – Electrical
   3. Section 26 29 23 – Variable Frequency Drives
   4. Section 40 90 00 – Instrumentation & Controls
   5. I/O list

1.2 REFERENCES

A. ISA 5.1 – Instrumentation Symbols and Identification

B. NEMA ICS 1 – General Requirements for Industrial Control and Systems

C. NEMA ICS 2 – Standards for Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated 600 Volts

D. DEMA ICS 3 – Industrial Control and Systems: Factory Built Assemblies

E. NEMA ICS 6 – Industrial Controls and Systems: Enclosures

1.3 DESIGN REQUIREMENTS

A. Discrete input/output signals shall all be 24VDC

B. Analog input/output signals shall all be 4-20mA

C. Analog signal isolators shall be independently powered units capable of driving two 4-20mA signals

D. All required buffers, isolators, signal converter, and amplifiers for coordination with other equipment furnished under other sections, and between items of equipment needed

for a complete system shall be furnished under this section of the specifications whether indicated on the Drawings or not or detailed in these specifications or not

1.4 SYSTEM DESCRIPTION

A. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
   1. I/O List. An I/O list is attached at the end of this section

1.5 SUBMITTALS

A. Submittals shall be required as noted in Section 40 90 00.

1.6 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be designed, coordinated, and supplied by the system integrator supplier.

B. Coordination
   1. The PLCs and PLC system shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer and the manufacturer of related equipment.
   2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
   3. The Contractor shall provide coordination with other contractors and supervision of installation as required during construction.

1.7 WARRANTY

A. The Supplier shall warrant the hardware, software, and configuration related to the operational performance of the facility for a period of two years from the date of system acceptance. The Supplier shall provide a two-year software service agreement to include any and all minor and/or major releases and upgrades and shall correct any problems or "bugs" which prohibit the SCADA system from performing process operations in accordance with these specifications.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMNTS

A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
   1. Interchangeability. All PLC systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules shall be interchangeable among all I/O panels and systems.
   2. Installed I/O requirements. Each PLC shall have I/O modules installed to accommodate requirements shown on drawings and the I/O List at the end of this section and with a minimum of 20% spares installed.
   3. Acceptable Manufacturers.
      a. PLC – Allen Bradley CompactLogix 5069 Series and no equal.
   4. Modules shall be added as needed to provide for all the I/O required on the project plus the spares.
   5. All Analog signals shall be logged in the Historian Software
   6. Autodialer alarms shall be selected and configured per the owner's requirements.

2.2 MATERIALS AND EQUIPMENT

A. Programmable Logic Controller (PLC)
   1. The additions to the PLC system shall include, but are not limited to, the following components:
      a. PLC Processor:
         i) 5380-l
      b. Input/Output Modules
         i) Digital Input Modules
            a) Number of Inputs: 12
            b) Voltage Category: 120VAC
            c) Module shall be Allen Bradley 5069-IA16.
         ii) Digital Output Modules
            a) Number of Outputs: 13
            b) Voltage Category: 120VAC
            c) Module shall be Allen Bradley 5069-OA16.
         iii) Analog Input Modules
            a) Number of Inputs: 5
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley 5069-IF8.
         iv) Analog Output Modules
            a) Number of Inputs: 2
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley 5069-OF8.

B. PLC Programming Software
   1. The PLC programming software shall be Allen Bradley 5000, no equal.

C. Existing HMI Software at Clifton WWTP
   1. Ignition HMI software manufactured by Inductive Automation
      a. Integrate New transfer station into existing SCADA system.
      b. All controls to be available at the HMI.
      c. Add trending for all analog signals at HMI.
      d. All alarms to be added to HMI.
      e. Flow and Level reports at the HMI.

D. SCADA Panel OIT
   1. Shall be Allen Bradley Panelview Plus or engineer approved equal.

E. Remote Access Equipment
   1. Firewall with SSL VPN Capability
      a. Fortigate 60F – No Equal
   2. Owner to Provide Internet Connection

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
   1. It shall be the Supplier's responsibility to ensure that the entire PLC system and HMI system is installed in a satisfactory condition per these specifications and the manufacturer's requirements.

B. Inspection
   1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
      a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation
   1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
      a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
      b. Perform all work in accordance with manufacturer's instructions.
         i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
         ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.

D. Adjustment and Cleaning

1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

E. PLC and HMI Programming.
1. The Contractor shall be responsible for all PLC and HMI programming.

3.2 CUSTOMER TRAINING
1. The system supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training sessions shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of two consecutive 4-hour working days, and the schedule shall be arranged and coordinated with the Engineer.

3.3

PALISADE SEWER TRANSFER STATION
I/O List

Tag #	Description	Address	DI	DO	AI	AO	Scale	Notes
LS-JA-1000	Utility Power Fail		1				120VAC	Internal to PLC Panel
LS-JA-1001	UPS Power Fail		1				120VAC	Internal to PLC Panel
LS-LSH-1002	Transfer Station Water on Floor Alarm		1				120VAC	
LS-TSL-1003	Transfer Station Low Temperature Alarm		1				120VAC	
LS-ZS-1004	Transfer Station Intrusion Alarm		1				120VAC	
LS-YI-1010	Generator Running		1				120VAC	
LS-YA-1010	Generator Fault		1				120VAC	
LS-LSL-1010	Generator Low Fuel Alarm		1				120VAC	
LS-ZS-1011	ATS In Emergency Position		1				120VAC	
LS-HC-1020	Odor Control S/S Command			1			120VAC	
LS-XA-1020	Odor Control General Fault		1				120VAC	
LS-LSH-1100	Wet Well Level Switch High		1				120VAC	
LS-LSL-1100	Wet Well Level Switch Low		1				120VAC	
LS-LIT-1100	Wet Well Level				1		4-20mA	
LS-AIT-1100	Wet Well Ph				1		4-20mA	
LS-AIT-1100	Wet Well Temperature				1		4-20mA	
LS-FIT-1101	Transfer Station Flow				1		4-20mA	
LS-PIT-1102	Forcemain Pressure				1		4-20mA	
LS-M-1110	Pump #1 Running						networked	
LS-MA-1110	Pump #1 Fault						networked	
LS-HS-1110	Pump #1 In Auto						networked	
LS-TA-1110	Pump #1 High Temperature						networked	
LS-YA-1110	Pump #1 Moisture Alarm						networked	

LS-SI-1110	Pump #1 Speed Feedback						networked	
LS-HC-1110	Pump #1 Start Command			1			120VAC	
LS-SC-1110	Pump #1 Speed Command					1	4-20mA	
LS-M-1120	Pump #2 Running						networked	
LS-MA-1120	Pump #2 Fault						networked	
LS-HS-1120	Pump #2 In Auto						networked	
LS-TA-1120	Pump #2 High Temperature						networked	
LS-YA-1120	Pump #2 Moisture Alarm						networked	
LS-SI-1120	Pump #2 Speed Feedback						networked	
LS-HC-1120	Pump #2 Start Command			1			120VAC	
LS-SC-1120	Pump #2 Speed Command					1	4-20mA	
LS-XA-1000	Utility Power Fail			1			120VAC	To Autodialer
LS-XA-1001	UPS Power Fail			1			120VAC	To Autodialer
LS-LAH-1002	Transfer Station Water on Floor Alarm			1			120VAC	To Autodialer
LS-TAL-1003	Transfer Station Low Temperature Alarm			1			120VAC	To Autodialer
LS-ZA-1004	Transfer Station Intrusion Alarm			1			120VAC	To Autodialer
LS-XA-1020	Odor Control General Fault			1			120VAC	To Autodialer
LS-LAH-1100	Wet Well Level Switch High			1			120VAC	To Autodialer
LS-LAL-1100	Wet Well Level Switch Low			1			120VAC	To Autodialer
LS-XA-1110	Pump #1 General Fault			1			120VAC	To Autodialer
LS-XA-1120	Pump #2 General Fault			1			120VAC	To Autodialer
	Totals		12	13	5	2		

END OF SECTION

SECTION 43 05 10
EQUIPMENT GENERAL PROVISIONS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies general requirements which are applicable to all mechanical equipment. The Supplier is responsible for ensuring that all mechanical equipment meets the requirements of this section in addition to the specific requirements of each individual equipment specification section.

B. Equipment Lists:

1. Equipment lists, presented in these specifications and as specified on the drawings, are included for the convenience of the Supplier and are not complete listings of all equipment, devices and material required to be provided under this contract. The Supplier shall prepare his own material and equipment takeoff lists as necessary to meet the requirements of this project manual.

1.2 QUALITY ASSURANCE

A. Arrangement:

1. The arrangement of equipment shown on the drawings is based upon information available to the Owner at the time of design and is not intended to show exact dimensions conforming to a specific Supplier. The drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from Supplier to Supplier.

B. References:

1. This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall

mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ABMA Std 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA Std 11	Load Ratings and Fatigue Life for Roller Bearings
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings, (Classes 25, 125, and 250)
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI S2.19	Mechanical Vibration – Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Unbalance, Including Marine Applications

C. Unit Responsibility:

1. Equipment assemblies made up of two or more components are to be provided as a working unit by the unit responsibility manufacturer, where specified. The unit responsibility manufacturer shall coordinate selection, coordinate design, and shall provide all mechanical equipment assembly components such that all equipment components furnished under the specification for the equipment assembly, and all equipment components specified elsewhere but referenced in the equipment assembly specification, is compatible and operates reliably and properly to achieve the specified performance requirements. Unless otherwise specified, the unit responsibility manufacturer shall be the manufacturer of the driven component equipment in the equipment assembly. The unit responsibility manufacturer is designated in the individual equipment specifications found elsewhere in this project manual. Agents, representatives or other entities that are not a direct division of the driven equipment manufacturing corporation shall not be accepted as a substitute for the driven equipment manufacturer in meeting this requirement. The requirement for unit responsibility shall in no way relieve the Contractor of his responsibility to the Owner for performance of all systems as provided in the General Conditions of the Contract Documents.

2. The Contractor shall ensure that all equipment assemblies provided for the project are products for which unit responsibility has been accepted by the unit responsibility manufacturer(s), where specified. Unit responsibility for related components in a mechanical equipment assembly does not require or obligate the unit responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them. Where an individual specification requires the Contractor to furnish a certificate from a unit responsibility manufacturer, such certificate shall conform to the content, shall be signed by an officer of the unit responsibility manufacturer's corporation and

shall be notarized. No other submittal material will be processed until a Certificate of Unit Responsibility has been received and has been found to be satisfactory. Failure to provide acceptable proof that the unit responsibility requirement has been satisfied will result in withholding approval of progress payments for the subject equipment even though the equipment may have been installed in the work.

D. Balance:

1. Unless specified otherwise, for all machines 10 HP and greater, all rotating elements in motors, pumps, blowers and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. All rotating elements shall be balanced to the following criteria:

$$U_{per} = 6.015 \frac{GW}{N}$$

Where:

U_{per} = *permissible imbalance, ounce-inches, maximum*

G = *Balance quality grade, millimeters per second*

W = *Weight of the balanced assembly, pounds mass*

N = *Maximum operational speed, rpm*

2. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data. Equipment balance quality grade shall be *G* 2.5 (*G* = 2.5 mm/sec) or better in accordance with American National Standards Institute (ANSI) S2.19.

PART 2 PRODUCTS

2.1 FLANGES AND PIPE THREADS

A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1, Class 125. Pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B1.20.1. Unless otherwise specified, flanges shall be flat faced.

C. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.2 BEARINGS

A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of American Bearing Manufacturers Association (ABMA) Methods of Evaluating Load Ratings of Ball and

Roller Bearings. Unless otherwise specified, equipment bearings shall have a minimum L-10 rating life of 50,000 hours. The rating life shall be determined using the maximum equipment operating speed.

B. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic alemite type.

C. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gage.

D. All bearings accessible to touch, and located within seven feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, fixed ladders or other access structures, shall either incorporate bearing housings with sufficient cooling to maintain surface temperature at 65°C or less for continuous operation at bearing rated load and a 50°C ambient temperature or shall be provided with appropriate shielding shall be provided that will prevent inadvertent human contact.

2.3 NOT USED

2.4 PUMP SHAFT SEALS

A. General:

1. Seals for water and wastewater pump shafts shall be mechanical seals. For industrial wastewater service, or for fluids other than water or municipal wastewater, the recommendations of the seal manufacturer shall be followed for selection of appropriate seals. Unless specified otherwise, mechanical seals shall conform to the requirements set forth in this paragraph.

B. Mechanical Seals:

1. Unless otherwise specified in the detailed pump specifications, mechanical seals shall be split mechanical seals requiring no field assembly, other than assembly around the shaft and insertion into the pump. They shall be self-aligning, and self-centering, single seals. They shall be of a nondestructive (nonfretting) type requiring no wearing sleeve for the shaft. Shafts for pumps specified with mechanical seals shall be furnished with no reduction in size through the seal area (no shaft sleeve). Where the detailed specifications call for cartridge instead of split seals, all other requirements of this paragraph apply.

2. Metal parts shall be Type 316 or 316L stainless steel. Springs shall be Hastelloy C, Elgiloy, or other Duplex SS selected for resistance to chloride attack. Rotary faces shall be silicon carbide or chrome oxide. Stationary faces shall be silicon carbide for solids bearing fluid service and carbon for clean water service.

Elastomers shall be ethylene propylene or fluorocarbon. Mechanical seals shall be suitable for operation between full vacuum (0 pounds per square inch absolute [psia]) up to 200 percent of the maximum specified operating pressure, but in any event not less than 200 pounds per square inch gauge (psig).

3. Seal chambers shall be provided with vented solids removal restriction bushings except for enclosed line shaft pumps where the seal barrier fluid is used for line shaft bearing lubrication. The bushing shall both control the amount of flushing water flow and restrict solids and gas accumulation from the seal face area.

4. Candidate seals include:

   a. Chesterton 442 seals provided with Chesterton/SpiralTrac solids removal restriction bushings Version N or D, as recommended by EnviroSeal Engineering Products, Ltd, Nova Scotia, Canada.

   b. AESSEAL RDS seals with Cyclops bushing.

   c. John Crane 3710 seals with Type 24SL bushing.

5. Seals on pumps for contaminated water service (sludge, grit, wastewater, scum, reclaimed water, etc.) shall be drilled and tapped for connection of a clean water flushing supply.

2.5 COUPLINGS

A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than ½-horsepower, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taper lock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

B. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.6 GUARDS

A. Exposed moving parts shall be provided with guards which meet all applicable Occupational Safety and Health Administration (OSHA) requirements. Guards shall be fabricated of 14-gage steel, 1/2-13-15 expanded metal screen to provide visual inspection of moving parts without removal of the guard. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance

of moving parts. Reinforced holes shall be provided. Lube fittings shall be extended through guards.

2.7 CAUTION SIGNS

A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "Caution - Automatic Equipment May Start At Any Time". Signs shall be constructed of fiberglass material, minimum ⅛-inch thick, rigid, suitable for post mounting. Letters shall be white on a red background. The sign size and pattern shall be as shown on the drawings. Signs shall be installed near guarded moving parts.

2.8 GAGE TAPS, TEST PLUGS AND GAGES

A. Gage taps shall be provided on the suction and discharge sides of pumps, blowers and compressors. Pressure and vacuum gages shall be provided where specified. Gage taps, test plugs, and gages shall be as specified in Division 40.

2.9 NAMEPLATES

A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation and equipment number. Equipment nameplates shall be engraved or stamped stainless steel and fastened to the equipment in an accessible and visible location with stainless steel screws or drive pins.

2.10 LUBRICANTS

A. The Manufacturer shall provide for each item of mechanical equipment a supply of the required lubricant adequate to last through the specified commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier. The Manufacturer shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing and adjusting equipment, the Manufacturer shall provide the Owner with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

2.11 ANCHOR BOLTS

A. Anchor bolts shall be designed for lateral forces for both pullout and shear. Contractor shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the Shop Drawings. Unless otherwise stated in the individual equipment specifications, anchor bolt materials shall be Type 316 stainless steel.

2.12 SPARE PARTS

A. Spare parts, wherever required by detailed specification sections, shall be stored in accordance with the provisions of this paragraph. Spare parts shall be tagged by project equipment number and identified by part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration, such as ferrous metal items and electrical components, shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than two feet wide, or 18 inches high, or three feet in length shall be stored in a wooden box with a hinged wooden cover and locking hasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

2.13 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Equipment Supports: Equipment components and supports, anchors, and seismic restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greatest of the following design criteria:
   1. Design Criteria noted in Section 01 60 10 – Design Requirements Non-Structural Components and Non-Building Structures.

B. Submit design calculations for equipment supports, anchors, and seismic restrainers signed and sealed by a licensed professional engineer registered in the State of Colorado. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, and normal operation plus wind loadings in accordance with Section 01 60 10 – Design Requirements Non-Structural Components and Non-Building Structures.
   1. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.
   2. Seismic requirements: Freestanding and wall-hung equipment shall be anchored in place by methods that satisfy Section 01 60 10 – Design Requirements Non-Structural Components and Non-Building Structures. Calculations shall be performed and signed and stamped for equipment weighing more that 400 pounds. Calculations shall analyze lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.
   3. Wind requirements: Exterior freestanding equipment shall be anchored in place by methods that satisfy Section 01 60 10 – Design Requirements Non-Structural Components and Non-Building Structures. Calculations shall be performed and signed and stamped, analyzing lateral and overturning forces and shall include a

factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

4. Equipment Foundations: Unless otherwise indicated, mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on concrete bases per Structural Details S-179 and S-188. Unless otherwise indicated on the Drawings, pumps, blowers, compressors and engine driven equipment shall be provided with a concrete foundation with a total weight equal to at least five times the weight of the equipment. Concrete foundations shall be isolated from the building floor in order to prevent transfer of vibration from the equipment to the building structure. The Contractor through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

5. Equipment Grout: Mechanical equipment installed on top of concrete foundations or bases shall be provided with non-shrink concrete grout as indicated and as specified in Section 03 60 00 - Grouting. Grout shall be applied between the base plate and the concrete foundation or base in accordance with the grout manufacturer's recommendation. Grout shall be free of void space.

PART 3 EXECUTION

3.1 GENERAL

A. Installation of equipment accessories included in this section shall be as recommended by the equipment manufacturer unless otherwise specified in the individual equipment specification section.

END OF SECTION

SECTION 43 25 04
DRY-PIT SUBMERSIBLE WASTEWATER PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes solids-handling, electric submersible pumps to be supplied with integral inverter-duty electric motors, rated explosion-proof by FM or UL for use in Class 1 Division 1, Groups C and D locations, and to be installed as dry-pit submersible raw-sewage pumps.

B. The specifications shall govern all work necessary to furnish, install and place into operation the electrical submersible pump(s) required to complete this project.

1.2 RELATED SECTIONS

A. Section 01 22 00 – Measurement and Payment

B. Section 01 33 00 – Submittal Procedures

C. Section 01 40 00 – Quality Requirements

D. Section 01 65 00 – Commissioning of Systems

E. Section 01 78 23 – Operation and Maintenance Data

F. Section 03 30 00 – Cast-in-place Concrete

G. Section 09 90 00 – Protective Coatings

H. Division 26 – Electrical

I. Division 43 – Material Handling Equipment

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements, and are suitable for the use intended.

C. Certify that the motor is inverter duty rated.

D. Submit a copy of this specification section, with addendum updates included, with each paragraph clearly marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. If deviations from the specifications are indicated and, therefore requested by the Contractor, the submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification for any requested deviations to the specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further consideration. The Owner retains the right to reject any proposed deviations in favor of this specification, as written.

E. Submit pump and motor performance data, pump curves showing operation points, submergence requirements, NPSH, bhp, efficiencies, and system head curves for each flow scenario.

a. The manufacturer shall indicate, by arrows to points on the Q/H curves, limits recommended for stable operation, between which the pumps are to be operated to prevent surging, cavitation, and vibration. The stable operating range shall be as large as possible, and shall be based on actual hydraulic and mechanical characteristics of the units and shall meet the hydraulic performance requirements of the proposed system.

F. Submit shop drawings showing pump dimensions, weights, materials of construction, detailed drawings for installation requirements and assembly, and pump connections and sizes.

G. Submit certified pump curves showing performance requirements are satisfied, prior to shipment. Full witnessed Hydraulic Institute performed pump tests are not intended

H. Submit electrical motor data.

I. Submit control drawing and data.

J. Submit manufacturer's standard recommended start-up report form

K. Provide written copies of manufacturer's warranties on products described in this specification section.

L. Submit Operation and Maintenance (O&M) Manuals in accordance with Section 01 78 23.

1.3 QUALITY ASSURANCE

M. Install and operate pumps and motors in accordance with the manufacturer's recommendations.

N. Unit responsibility: To ensure coordination, all pumps, motors, power cable, base elbows, control panel, and accessories shall be supplied by one pump manufacturer.

1.4 WARRANTY

A. Warranty: Include coverage of all pumps, motors, bearings, seals, wear plates, and accessories for a minimum of one (1) year from the date of startup and prorated for a period of five (5) years from the date of startup.

B. Warrant all equipment provided under this section, regardless of whether it is manufactured by the pump manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the pump supplier shall service the pumps and motors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and storage in accordance with the manufacturer's recommendations.

B. Protect equipment from exposure to elements and keep all items dry.

C. Store motors, electrical equipment, and other equipment with moving parts in weather tight enclosures.

D. Painted Surfaces: Protect against impact, abrasion, discoloration, and other damage.

E. Protect electrical equipment, controls, and insulation against moisture or water damage.

PART 2 PRODUCTS

2.1 GENERAL

A. The pumps shall be suitable for pumping raw sewage and shall be designed and fully guaranteed for this use. The fluid temperature range shall be from 40 degrees to 104 degrees F.

B. Pump shall be capable of operating in a continuous non submerged condition in vertical (NT) position in a dry pit installation and permanently connected to inlet and outlet pipes. Pump shall be of submersible construction and will continue to operate satisfactorily should the dry pit be subjected to flooding.

2.2 PERFORMANCE REQUIREMENTS

A. Provide two (2) dry-pit submersible centrifugal sewage pumps and motors meeting the requirements of this specification.

B. Pump and Motor Design:

1. Continuous operating service at any and all points within the specified range of operation, without overheating, without damaging cavitations, and without excessive vibration or noise at site conditions, elevations, and expected ambient temperatures.
2. Suitable for pumping raw unscreened sewage
3. Discharge elbow permanently installed in dry-pit, pump suction installed in wet well.
4. Be easily removed for inspection and service requiring removal of no bolts, nuts, or other fastenings and do not require personnel to enter the wet well.
5. Rated for explosion proof, Class 1, Division 1, Group C and D hazardous locations.
6. Non-overloading throughout the entire range of operation without employing a service factor.

C. Design Operating Conditions:

1.	Minimum hydraulic efficiency, %	60
2.	Nominal pump speed, rpm	1770
3.	Total Dynamic Head, feet	120
4.	Motor horsepower, hp	45
5.	Power supply	460V, 3 phase, 60 Hz
6.	Discharge diameter, inches	4
7.	Site elevation, feet	4,680

2.3 MANUFACTURER

A. The following manufacturers meet the performance requirements of this specification and are also subject to the requirements of these specifications. Manufacturers meeting the requirements of this specification but not listed below may be considered with proper documentation.

B. Xylem Water Solutions Flygt Products NT Model 3202 HT 3-468.

2.4 PUMP CONSTRUCTION

A. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the sewage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic

dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

Each unit shall be provided with an integral motor cooling system. A motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F. (40°C.). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

2.5 VOLUTE / SUCTIN COVER

A. The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have integral spiral-shaped, sharp-edged groove(s) that is cast into the suction cover. The spiral groove(s) shall provide the sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide effective sealing between the multi-vane semi-open impeller and the volute.

2.6 MECHANICAL SEALS

A. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. 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 are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for

lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

2.7 PUMP SHAFT

A. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be AISI type 431 stainless steel. Shaft sleeves will not be acceptable.

2.8 IMPELLER

A. The impeller shall be of gray cast iron, ASTM A-48 Class 35B, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impellers shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

2.9 BEARINGS

A. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve

2.10 MOTOR

A. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180^{o}C (356^{o}F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while

handling pumped media of up to 104°F. The motor shall be capable of withstanding at least 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C. ambient and shall have a NEMA Class B maximum operating temperature rise of 80° C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.

2.11 PROTECTION

A. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

B. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify all pumps, motors, and materials are present and meet the requirements of these Specifications.

3.2 START-UP SERVICES

A. Provide a factory-trained representative to demonstrate operation and maintenance of the pump and motors to the Owner. At a minimum, services shall be provided over a period of four (4) hours. Report shall be submitted to the Engineer at completion.

B. Demonstrate automatic operation of pumping systems including verification of controller set points.

C. Test start five (5) times in automatic mode at a minimum and operate pump, and completed system for a continuous test period of one (1) hour for each test. Record all unit operating functions, pump discharge flow rate and pressure. Current load and voltage of each pump during drawdown testing.

D. Perform a drawdown test at the sewage lift station prior to connection with sanitary sewer systems to verify pumping performance of both units. Contractor shall provide water supply to perform this test. A minimum of five (5) cycles per pump shall be performed. Measure liquid level verses pumping time to establish an average pumping rate of each pump.

3.3 TESTING

A. Shop Tests: Pumps and Motors

1. Each pump and motor shall be performance tested as specified hereinafter; all pumps shall be tested with motor cables to be supplied with the pumps. Three copies of certified test reports, including actual test records, shall be submitted and approved by the Engineer prior to shipment of the equipment.

2. Each pump shall be tested for performance at the factory to determine the head vs. capacity, motor total electrical power draw (KVA), and motor active electrical power draw (KW) for the full speed at which the pumps are specified and shown on a performance test curve, certified by a registered professional engineer, as continuous functions throughout the pump's performance range. Tests of models, prototypes or similar units will not be acceptable.

3. All tests shall be run in accordance with the test code for centrifugal pumps of the Standards of Hydraulic Institute, latest edition. The motor and cable on each pump shall be tested for moisture content or insulation defects. After the test, the pump cable end shall be fitted with a shrink-fit rubber boot to protect it from moisture or water.

B. Field Tests: Field testing shall be composed of preliminary tests and acceptance tests. The Contractor shall provide the services of authorized equipment supplier's representatives to conduct all field tests.

1. Preliminary tests shall be run on all pumps, motors, and control systems at start-up to demonstrate that they are in proper working order. Voltage, current, and other significant parameters shall be recorded. The Manufacturer shall provide a formal test procedure and forms for recording data.

2. Acceptance tests shall be run to demonstrate that the pumping units, motors and control system meet the following requirements:

a. The pumping units operate as specified without excessive noise, cavitation, vibration, and without overheating of the bearings.

b. All automatic and manual controls function in accordance with the specified requirements.

c. All drive equipment operates without being overloaded.

END OF SECTION

SECTION 43 30 00
HYDRAULIC PROCESS VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnishing and installing valves as shown and specified. In addition, valve-operating units, stem extensions and other accessories shall be furnished and installed by the Contractor where shown, or where required in the opinion of the Engineer, to provide for convenience in operation. Where buried valves are indicated, the Contractor shall furnish and install valve boxes to grade per the Standard Details – see Drawings. All valves shall be new and of current manufacture.

B. Not all valves and operators listed in this section are used in this project.

1.2 RELATED SECTIONS

A. Section 09 90 00 – High Performance Coatings

B. Section 40 06 00 – Pipe and Fittings

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Shop drawings of all valves and operators, including wiring diagrams and electrical data, shall be furnished as specified in Section 01 33 00.

C. Submit manufacturer's installation instructions and maintain copy at job site.

D. Project Record Drawings: Record actual locations of valves, operators, and accessories.

E. Service: Valve shall be suitable for the specific service conditions, (e.g., raw sewage, sludge, specific chemical, potable water, and etc.). Submit product information verifying valve is compatible with intended service conditions.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01 73 00.

B. Maintenance Data: Include installation and maintenance instructions, recommended spare parts lists, and exploded view of valves, gates, operators, and accessories.

1.5 QUALITY ASSURANCE

A. Manufacturer's name and pressure rating marked on valve body.

B. Perform work in accordance with manufacturer's recommendation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products at job site under provisions of Section 01 60 00.

B. Accept valves, operators, and accessories in shipping containers with labeling in place in accordance with American Water Works Association (AWWA) C-501. Inspect for damages.

C. Seal valve ends and gate ends to prevent entry of foreign materials.

1.7 TAGS AND IDENTIFICATION

A. Permanent tags shall be provided for every valve, instrument and gate.

1.8 DEFINITIONS

A. Abbreviations used in Detailed Valve Specification Sheets:

ARV-Air Release Valve
BV- Ball Valve
BFV - Butterfly Valve
CV- Check Valve
CS- Corporation Stops
CB - Circuit Balancing Valve
DPV – Diaphragm Valve
FLV-Flap Valve
GL- Globe Valve
GV- Gate Valve
KGV-Knife Gate Valve
MV - Mud Valve
NV - Needle Valve
PRV-Pressure Regulating Valve
PIV-Pinch Valve
PV - Plug Valve
SGV – Shear Gate Valve
SV – Solenoid Valve

PART 2 PRODUCTS

2.1 GENERAL

A. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

B. Unless otherwise specified, all interior bronze parts of valves except gate valve stems shall conform to the requirements of the “Specification for Composition Bronze or Ounce Metal Castings,” (ASTM B62). Gate valve stems shall be of bronze containing not more than five percent of zinc nor more than two percent of aluminum, and shall have a minimum tensile strength of 60,000 pounds per square inch (psi), a yield strength of 40,000 psi, and an elongation of at least 10 percent in two inches, as determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured.

C. The flanges of valves may be raised or plain faced. Flanges of valves for water-working pressures of 175 psi or less shall be faced and drilled to 125-pound American Standard

template. Flanges of valves for water-working pressures greater than 175 psi shall be faced and drilled to 250-pound American Standard template.

D. Valve Operators:

1. Unless otherwise shown or specified, manual handwheel operators, with position indicators, shall be provided for 6-inch valves and larger. Lever operators may be supplied on quarter-turn-type valves smaller than six inches; however, operator force shall not exceed 40 pounds under any operating condition, including initial breakaway.

2. Operators of the worm-and-gear-type shall have self-locking worm gears. The operators on quarter-turn-type valves shall be of the self-locking-type to prevent the plug or disc from creeping, and shall be provided with position indicators to show the position of the plug or disc. Lever-type operators on exposed valves shall have some means of being fixed in any position to prevent movement.

3. Buried operators on valves larger than two inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2-inch and smaller shall have a T-handle for operation by forked key, unless otherwise shown or specified.

4. All buried valves shall be installed with valve boxes. When the valve centerline is more than four feet below the finished grade, extension stems are required.

E. All moving parts of buried valves and operators shall be enclosed in the housing to prevent contact with the soil.

F. Unless otherwise shown or specified, all exposed nuts, bolts, washers, and springs shall be stainless steel.

G. Where designated, certain valves shall be furnished with electric operators provided by the valve manufacturer. All operators of a given type shall be furnished by the same manufacturer. Where these operators are supplied by different valve manufacturers, the Contractor shall coordinate their operator selections to provide uniformity of each type of electric operator.

H. Unless specifically required to be equipped with other types of operators, all valves with centerline more than 6 feet above the operating floor shall be equipped with chain wheels and operating chains. Each chain-wheel-operated valve shall be equipped with a chain guide that will permit rapid handling of the operating chain without “gagging” of the wheel. Lever operated valves shall be provided with operating chains.

I. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other divisions of these Specifications. It shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

J. Strainer shall be provided ahead of any electric solenoid control valves and regulators.

K. Valve Boxes: Valve boxes, except those noted as special design required on the Drawings, shall be of cast iron of the two-piece extension-type with cast iron cover. The extension shall provide for the maximum depth of cover over the pipe in which the valves are to be used. Valve boxes shall have walls not less than 3/16-inch thick at any point, and the internal diameter shall be not less than five inches. Valve box covers shall have the word "SEWER" or "WATER" cast into them as appropriate to their place of use. All valves underground shall be installed with valve boxes.

L. Miscellaneous Valves: Where indicated on the Drawings, but not specifically identified, Contractor shall furnish and install miscellaneous valves per this specification. Valves shall be high quality and suitable for the indicated service, and approved by the Engineer.

2.2 VALVE DATA PRODUCT INFORMATION SHEETS

A. Individual data sheets for each valve type are included following this section.

PART 3 EXECUTION

3.1 INSTALLATION

A. All valves shall be installed in accordance with good trade practices and the manufacturer's instructions and recommendations.

B. Unless otherwise indicated on the Drawings, all valves installed in horizontal pipe runs having a centerline elevation four foot six inches or less above the finished floor shall be installed with their operating stem vertical. If adjacent piping prohibits this, the valves shall have their operating stems orientated to facilitate the most practical operation. Valves installed in horizontal pipe runs having a centerline elevation greater than four foot six inches above the finished floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems orientated to facilitate the most practicable operation.

C. Provide all necessary fittings to install valve at the location shown in the Plans.

D. All plug valves installed in sludge lines shall be installed with the seat on the upstream side.

3.2 PAINTING

A. All valves unless otherwise specified, shall be painted in accordance with Section 09 90 00.

1. The exterior surfaces of all interior and submerged valves shall be epoxy coated with three to five MDFT of epoxy-polyamide primer in preparation for coating, as specified in Section 09 90 00.

B. All buried valves shall be coated with the manufacturer's fusion bonded epoxy, suitable for buried service.

3.3 TESTING

A. All equipment shall be tested in accordance with Section 46 and Section 40 06 00 as part of a completed system.

B. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test.

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Air Release Valve

TYPE OF VALVE		**SYMBOL**	
Air Release Valve		ARV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**ITEM**	**ITEM**	**ITEM**
Shell	Cast Iron ASTM A536	**Type of Service**	Water (Note 2)
Body/Base	Reinforced Nylon (A.R.I.) Cast Iron (GA)	**Reference Document**	AWWA C512
Discharge	Brass ASTM B-124	**Size Range**	½" to 1"
Seals	EPDM	**Body/Valve Ends**	NPT
Float	Foamed Polypropylene	**Pressure Rating (psi)**	10 to 150 (GA) 3.0 to 250 (A.R.I.)
O-Ring	Buna-N	**Temperature Rating (deg C)**	60 C
Bolts/Screws	Stainless Steel	**Testing**	
Strainer	Nylon	**Operator**	NA
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Suitable for venting small amounts of air under normal service conditions.			
3. Provide all necessary fittings and isolation to install the valve at the location shown in the plans.			
ACCEPTABLE PRODUCTS			
A.R.I. S-050-C	GA Industries Figure 905		

Air Release Valve

TYPE OF VALVE		**SYMBOL**	
Combination Air Vacuum / Release Valve		ARV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS (Note 1)**	**Type of Service**	Water (Note 2)
Shell	Stainless Steel	**Reference Document**	AWWA C512
Body/Base	Stainless Steel	**Size Range**	1/2" to 2"
Discharge	Polypropylene	**Body/Valve Ends**	NPT
Seals	EPDM	**Pressure Rating (psi)**	3 to 250
Float	Foamed Polypropylene	**Temperature Rating (deg C)**	
O-Ring	Buna-N	**Testing**	
Bolts/Screws	Stainless Steel	**Operator**	NA
Strainer	None	**Actuator**	NA

NOTES
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.
2. Suitable for venting air and protection from vacuum under normal service conditions.
3. Provide all necessary fittings and isolation to install the valve at the location shown in the plans.
4. Install the combination air release/vacuum valve on the discharge piping as shown in the plans to rid the piping of entrapped air during normal operating conditions and allow air to exit/enter the piping during filling/emptying conditions.

ACCEPTABLE PRODUCTS		
A.R.I. D-040-ST-ST		

Air Release Valve

TYPE OF VALVE		**SYMBOL**	
Combination Air Vacuum / Release Valve		ARV-3	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Sewage (Note 1)
Shell	No Shell	**Reference Document**	AWWA C512-15
Body/Base	316 SS	**Size Range**	2" to 4" (Note 3) 2" to 8" (Note 4)
Discharge	Polypropylene	**Body/Valve Ends**	NPT or FL per plans
Seals	EPDM	**Pressure Rating (psi)**	1.0 to 150 (Note 3) 3.0 to 250 (Note 4)
Float	Foamed Polypropylene	**Temperature Rating (deg C)**	60 C
O-Ring	Buna-N	**Testing**	
Bolts/Screws/Springs	Stainless Steel SAE 316	**Operator**	NA
Strainer	None	**Actuator**	NA
NOTES			
1. Install the combination air release/vacuum valve on the discharge piping as shown in the plans to rid the piping of entrapped air during normal operating conditions and allow air to exit/enter the piping during filling/emptying conditions.			
2. Provide all necessary fittings and isolation to install the valve at the location shown in the plans			
3. 2" to 4", reduced height unit, 1.0 to 150 psi			
4. 2" to 8", full height unit, 3.0 to 250 psi			
ACCEPTABLE PRODUCTS			
A.R.I. D-025 (Note 3)	A.R.I.-D-026 (Note 4)	GA Industries 842 SS	

Example sizing chart:

A.R.I. D-26 Combination Valve Sizing Chart			
	Maximum Flow Rate (A, B)		
Nominal Valve Size (in)	**(cfs)**	**(cfm)**	**(gpm)**
2	8	500	3,740
3	17	1,000	7,481
4	33	2,000	14,961
6	83	5,000	37,403
8	183	11,000	82,286
(A) Maximum flow rate is the maximum orifice flow rate anticipated through a broken process pipe at the lowest point (elevation) in system. Orifice size is assumed to be either ½ or 1/3 of nominal pipe diameter.			

(B) When filling or draining process pipeline.

(C) Submit manufacturer sizing chart for alternative valve selections.

Air Release Valve

TYPE OF VALVE		**SYMBOL**	
Air Release Valve		ARV-4	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Sewage (Note 1)
Shell	N/A	**Reference Document**	AWWA C512
Body/Base	Reinforced Nylon	**Size Range**	2”
Discharge	Polypropylene	**Body/Valve Ends**	NPT or FL per plans
Seals	EPDM	**Pressure Rating (psi)**	3 to 150
Float	Foamed Polypropylene	**Temperature Rating (deg C)**	60 C
O-Ring	Buna-N	**Testing**	
Bolts/Screws/Springs/Stems	Stainless Steel SAE 316	**Operator**	NA
Strainer	None	**Actuator**	NA
NOTES			
1. Suitable for venting air small amounts of accumulated air under normal service conditions.			
2. Provide all necessary fittings and isolation to install the valve at the location shown in the plans.			
ACCEPTABLE PRODUCTS			
A.R.I. S-025			

Air Release Valve

TYPE OF VALVE		SYMBOL	
		ARV-5	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**ITEM**	**ITEM**	**ITEM**
Shell		**Type of Service**	Chemical
Body/Base	PVDF	**Reference Document**	AWWA C512
Discharge	Polypropylene, PVDF	**Size Range**	½" to 2"
Seals	Viton	**Body/Valve Ends**	NPT
Float	Foamed ASA	**Pressure Rating (psi)**	3.0 to 250 (A.R.I.)
O-Ring	Viton	**Temperature Rating (deg C)**	60 C
Bolts/Screws		**Testing**	
Strainer		**Operator**	NA
NOTES			
4. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
5. Suitable for venting air and protection from vacuum under normal service conditions.			
6. Provide all necessary fittings and isolation to install the valve at the location shown in the plans.			
ACCEPTABLE PRODUCTS			
A.R.I. D-040			

Ball Valve

TYPE OF VALVE		**SYMBOL**	
Ball Valve		BV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Air or Water
Body	Bronze	**Reference Document**	
Ball	Hard chrome plated brass ball	**Size Range**	≤2”
Seats	Glass reinforced Durafil or PTFE	**Body/Valve Ends**	NPT, FNPT, Solder as required on drawings with Single Union, union end type
Shaft/Stem	Brass ASTM B16 or SS	**Pressure Rating (psi)**	600 pound WOG
Elastomers		**Temperature Rating (deg C)**	200 °F
Seals	PTFE	**Testing**	
		Operator	Lever Handle-and with screwed ends; 2” Nut (Buried Service)
		Actuator	Manual, lever type
NOTES			
1. Bronze Valves shall be used in copper pipe lines. Valves shall be NSF 61 Certified for Potable Water application–Lead free.			
ACCEPTABLE PRODUCTS			
Watts Series B-6000	Mueller	Apollo 70LF-100 / 200	

Ball Valve

TYPE OF VALVE		**SYMBOL**	
Ball Valve		BV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Air, Water, Process Water
Body	SS	**Reference Document**	
Ball	SS	**Size Range**	<3”
Seats	Teflon	**Body/Valve Ends**	NPT, FNPT, Solder as required on drawings with Single Union
Shaft	SS	**Pressure Rating (psi)**	600 pound WOG
Elastomers		**Temperature Rating (deg C)**	
		Testing	
		Operator	Lever Handle
		Actuator	

NOTES

1. SS Valves shall be used in SS pipe lines. Valves shall be NSF 61 Certified for Potable Water applications -Lead free.
2. Ball valve must have a union fitting, lockable handle, and imprinted tagging.

ACCEPTABLE PRODUCTS

Watts	Mueller	Apollo 76F-100 / 200
	Swagelok Series 40 (up to ¾”)	

Ball Valve

TYPE OF VALVE		**SYMBOL**	
Ball Valve		BV-3	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Sodium Hypochlorite <15%,(or Chlorine Gas Solution)
Body	PVC Type 1	**Reference Document**	
Ball	PVC Type 1 – ***VENTED PORT BALL***	**Size Range**	<2”
Seats	PTFE Seats	**Body/Valve Ends**	True Union with Socket Weld (Note 1)
Shaft		**Pressure Rating (psi)**	150 PSI
Elastomers	PTFE seats or Viton/FKM	**Temperature Rating (deg C)**	
		Testing	
		Operator	Lever Handle or T Handle
		Actuator	

NOTES

1. Valve shall have threaded double-union body that can be removed from the line without disengaging the end connections
2. Valves for sodium hypochlorite service shall be provided with a vented ball and viton/FKM seals.
3. Valves used for Sodium Hydroxide Service shall have flanged connections

ACCEPTABLE PRODUCTS		
Georg Fischer Type 546	Asahi/America Type-21	Spears Mfg. Company 1839V series
Hayward Flow Control		

Ball Valve

TYPE OF VALVE		**SYMBOL**	
Ball Valve		BV-4	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Water, Process Water, Chemical (Ferric Chloride, Sodium Bisulfite, Aluminum Sulfate, Sodium Hydroxide (Note 2), or Citric Acid
Body	PVC Type 1	**Reference Document**	
Ball	PVC Type 1	**Size Range**	4" and smaller
Seats	PTFE	**Body/Valve Ends**	True Union with Socket Weld (Note 1)
Shaft		**Pressure Rating (psi)**	150 PSI
Elastomers	PTFE Seats, EPDM or Viton/FKM (Note 2)	**Temperature Rating (deg C)**	
		Testing	
		Operator	Lever Handle or T Handle
		Actuator	Electric (when noted)

NOTES
1. Valve shall have threaded double-union body that can be removed from the line without disengaging the end connections
2. When used with sodium hydroxide, valve elastomers shall be PTFE only.

ACCEPTABLE PRODUCTS		
Georg Fischer Type 546	Asahi/America Type-21 (Series 94 electric actuator when noted)	Cabot - Chemtrol True Union (TU) Series
	Hayward Flow Control	Spears Mfg. Company 1829/1839 series (CTQ series electric actuator when noted)

Butterfly Valve

TYPE OF VALVE		**SYMBOL**	
Butterfly Valve		BFV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water, Compressed Air; Interior Exposed Mechanical
Body	One piece cast iron or ductile iron body.	**Reference Document**	AWWA C504
Disc	The disc shall be secured to the shaft using at least two Type 316 stainless steel pins or self-locking setscrews. 316 stainless steel disc.	**Size Range**	3" to 30"
Bushings/ Bearings	All valves shall be furnished with two upper bearings/bushings and one lower bearing/bushing of PTFE material **or Nylatron.**	**Body/Valve Ends**	125/150# pattern Lugged Style (Note 2) AWWA Valves to be Flanged
Pins	Stainless Steel.	**Pressure Rating (psi)**	150 PSI Liquid, Air or Vacuum Service for AWWA Valves, Bi-Directional "dead end" or 175 psi with directional (with disc)/100 psi (against disc) "dead end" bubble tight shutoff capability without the use of backing flanges.
Shaft/ Stem	316 or 416 Stainless Steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.	**Temperature Rating (deg C)**	
Seats/ Seals	Valve seats shall be of the reinforced resilient type and shall be field replaceable (in sizes over 24" on AWWA valves). Seats on Lugged Valves shall also act as a body liner to prevent flow from contacting the body casting. Seats on Industrial Valves shall have flange sealing to provide a positive seal without use of flange gaskets. Water Service: EPDM; Compressed Air Service (high pressure): PTFE; Process Air Service (low pressure): Fluorocarbon (Viton, RTFE, or Fluorinated Hydrocarbon Elastomer	**Testing**	Factory Testing shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.

	ASTM D1418) rated for 350° minimum or higher if required by process.		
Packing		**Operator**	4” Lever Handle, >4” Geared Handwheel /Chainwheel
Backing Ring		**Actuator**	Electric actuators or Pneumatic or Manual as shown on the plans and as specified in Section 15106 and Division 16. (Note 2). Include Manual Override.

NOTES

1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free and AWWA Compliant
2. Valve shall be capable of being installed vertically or horizontally; and have the ability to be installed with the disc in the closed position.

ACCEPTABLE PRODUCTS

Bray Series 30/31	Keystone	Pratt Series BF, 2FII or Triton

Butterfly Valve

TYPE OF VALVE		**SYMBOL**	
Butterfly Valve		BFV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water. Exposed Interior Mechanical Service Automated – Modulating and Cyclic Service (Note 3).
Body	316 Stainless Steel	**Reference Document**	
Disc	316 Stainless Steel	**Size Range**	2" to 30"
Bushings/ Bearings	EPDM or RTFE	**Body/Valve Ends**	125/150# pattern Lugged Style (Note 2)
Pins	316 Stainless Steel	**Pressure Rating (psi)**	150 PSI Liquid, Air or Vacuum Service Bi-Directional. Valves shall provide ANSI Class VI shutoff
Shaft/ Stem	17-4PH stainless steel or 316 stainless steel	**Temperature Rating (deg C)**	
Seats/ Seals	Water Service: EPDM, Teflon; Compressed Air Service (high pressure): PTFE, Teflon; Process Air Service (low pressure): Fluorocarbon (Viton or RTFE or Fluorinated Hydrocarbon Elastomer – ASTM D1418) rated for 300° minimum or higher if required by process	**Testing**	Factory Testing shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.
Packing	PTFE	**Operator**	4" Lever Handle, >4" Geared Handwheel /Chainwheel
Backing Ring	Stainless Steel	**Actuator**	Electric actuators or Pneumatic as shown on the plans and as specified in Section 15106 and Division 16. (Note 3). Include Manual Override.
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.			
2. Valve shall be capable of being installed vertically or horizontally; and have the ability to be installed with the disc in the closed position.			

3. Valve shall be suitable for pneumatically or electrically automated in on/off service, modulating, or throttling service and classified as a "High Performance Butterfly Valve," and shall utilize an offset disc design with a soft seat.		
ACCEPTABLE PRODUCTS		
Bray Series 40/41	Keystone	Pratt Series HP

Butterfly Valve

TYPE OF VALVE		**SYMBOL**	
Butterfly Valve		BFV-3	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water with chlorine solution 50 ppm to 1000 ppm. Interior Exposed Mechanical.
Body	One piece cast iron or ductile iron body	**Reference Document**	
Disc	PVDF Coated Disc	**Size Range**	2" to 12"
Bushings/ Bearings	All valves shall be furnished with two upper bearings/bushings and one lower bearing/bushing of PTFE material. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion	**Body/Valve Ends**	125/150# pattern Lugged Style (Note 2)
Pins	Stainless Steel	**Pressure Rating (psi)**	150 PSI Liquid, Air or Vacuum Service Bi-Directional
Shaft/ Stem	316 or 416 Stainless Steel	**Temperature Rating (deg C)**	
Seats/ Seals	Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing to provide a positive seal without use of flange gaskets EPDM or Viton as required by service conditions and chemical exposure. Verify material is suitable for specific chemical exposure.	**Testing**	Factory Testing shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.
Packing		**Operator**	4" Lever Handle, >4" Geared Handwheel /Chainwheel

Backing Ring		**Actuator**	Electric actuators or Pneumatic as shown on the plans and as specified in Section 15106 and Division 16. (Note 2). Include Manual Override.
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.			
2. Valve shall be capable of being installed vertically or horizontally; and have the ability to be installed with the disc in the closed position.			
ACCEPTABLE PRODUCTS			
Bray Series 22/23	Keystone - Resilient Seated Valve Types 920	Pratt Series BF	

Butterfly Valve

TYPE OF VALVE		**SYMBOL**	
Butterfly Valve		BFV-4	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water. Buried.
Body	Cast iron (ASTM A-126)	**Reference Document**	AWWA C504
Disc	Ductile iron	**Size Range**	4" to 36"
Bushings/ Bearings		**Body/Valve Ends**	125/150# pattern FL or MJ as shown on the drawings (Note 2)
Pins		**Pressure Rating (psi)**	150 PSI Liquid, Air or Vacuum Service Bi-Directional
Shaft/ Stem	316 stainless steel shaft with o-ring seals	**Temperature Rating (deg C)**	
Seats/ Seals	BUNA-N seal	**Testing**	Factory Testing shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.
Packing		**Operator**	2" Nut, fully gasketed. Minimum 24 turns from open to closed
Backing Ring		**Actuator**	NA
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.			
2. Valve shall be capable of being installed vertically or horizontally.			
ACCEPTABLE PRODUCTS			
Pratt – Groundhog	Mueller	Clow BFV 4500 (3" to 24") Clow BFV 1450 (30" to 36")	

Butterfly Valve

TYPE OF VALVE		**SYMBOL**	
Butterfly Valve		BFV-5	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water
Body	PVC or CPVC (Note 3)	**Reference Document**	ANSI B16.10
Disc	PVC or CPVC (Note 3)	**Size Range**	2" to 12"
Bushings/ Bearings		**Body/Valve Ends**	125/150# pattern FL (Note 2)
Pins		**Pressure Rating (psi)**	150 PSI Liquid, Air or Vacuum Service Bi-Directional
Shaft/ Stem	316 stainless steel shaft	**Temperature Rating (deg C)**	
Seats/ Seals	Nitrile liner	**Testing**	Factory Testing shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.
Packing		**Operator**	
Backing Ring		**Actuator**	NA
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.			
2. Valve shall be capable of being installed vertically or horizontally.			
3. Body and disc material shall match that of the process pipe on which it is installed.			
ACCEPTABLE PRODUCTS			
Hayward Flow Control			

Check Valve

TYPE OF VALVE		**SYMBOL**	
Swing Check Valve		CV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Liquid (Water or Sewage)
Body	PVC	**Reference Document**	PVC shall conform to ASTM D1784 cell classification 12454
Hardware		**Size Range**	< 8”
Ball		**Body/Valve Ends**	FL (Note 2)
Type of Disc	Swinging Inclined Disc	**Pressure Rating (psi)**	150 PSI
Disc	PVC	**Temperature Rating (deg C)**	
Trim	316 SS	**Testing**	
Packing	EPDM Seals	**Operator**	External SS Spring Assist. Or Lever/weight
Shaft	316 SS	**Actuator**	
Seats	EPDM		
Bonnet	PVC Removable w/ SS hardware		
Elastomers			
Cover			
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Valve shall be capable of being installed vertically or horizontally.			
ACCEPTABLE PRODUCTS			
Asahi/America		Spears Mfg. Company 4423 series	

Check Valve

TYPE OF VALVE		**SYMBOL**	
Swing Check Valve		CV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Liquid (Water or Sewage)
Body	Cast Iron, factory epoxy coated interior	**Reference Document**	AWWA C508
Type of Disc	Swinging Inclined Disc	**Size Range**	4" to 24"
Disc	Cast Iron, epoxy coated	**Body/Valve Ends**	FL or MJ per drawings
Trim	304 SS	**Pressure Rating (psi)**	
Shaft	304 SS	**Temperature Rating (deg C)**	
Seats	Bronze with (NBR) rubber seat ring	**Testing**	
Packing		**Operator**	External SS Spring Assist or Lever and adjustable Weight.
Bonnet	Cast Iron, factory epoxy coated interior	**Actuator**	
Elastomers	NBR rubber	**Installation**	(Note 2)
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Valve shall be capable of being installed vertically or horizontally.			
ACCEPTABLE PRODUCTS			
Mueller	Kennedy	Pratt Series 8001	Golden Anderson (VAG/GA Industries)

Check Valve

TYPE OF VALVE		**SYMBOL**	
PVC Ball Check Valve		CV-3	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Sodium Hypochlorite <15%,(or Chlorine Gas Solution)
Body	PVC Type 1	**Reference Document**	
Hardware		**Size Range**	<2”
Ball	PVC Type 1	**Body/Valve Ends**	Union with Socket Weld (Note 1)
Type of Ball		**Pressure Rating (psi)**	150 PSI
Disc		**Temperature Rating (deg C)**	
Trim		**Testing**	
Packing		**Operator**	
Shaft		**Actuator**	
Seats	PTFE seats or Viton/FKM		
Bonnet			
Elastomers			
Cover			

NOTES
1. Valve shall be capable of being installed vertically or horizontally.
2. The valve shall permit flow in direction only and close tightly, without slamming, when its discharge pressure exceeds its inlet pressure.
3. The valve shall operate without hydraulic shock and require no maintenance.
4. Valve flow area shall be 100% of the nominal pipeline diameter cross sectional area. Valve body interior shall be designed with smooth surfaces with no projections or pockets to trap solid material.

ACCEPTABLE PRODUCTS		
Georg Fischer Type 561	Asahi/America Ball Check	Spears Mfg. Company 4539 series
Hayward Flow Control		

Check Valve

TYPE OF VALVE		**SYMBOL**	
PVC Ball Check Valve		CV-4	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Ferric Chloride, Sodium Bisulfite, Aluminum Sulfate or Citric Acid
Body	PVC Type 1	**Reference Document**	
Hardware		**Size Range**	<2”
Ball	PVC Type 1	**Body/Valve Ends**	Union with Socket Weld (Note 1)
Type of Ball		**Pressure Rating (psi)**	150 PSI
Disc		**Temperature Rating (deg C)**	
Trim		**Testing**	
Packing		**Operator**	
Shaft		**Actuator**	
Seats	PTFE Seats, EPDM or Viton /FKM		
Bonnet			
Elastomers			
Cover			
NOTES			
1. Valve shall be capable of being installed vertically or horizontally.			
ACCEPTABLE PRODUCTS			
Georg Fischer Type 561	Asahi/America Ball Check	Spears Mfg. Company 4529 /4539 series	
Hayward Flow Control			

Check Valve

TYPE OF VALVE		**SYMBOL**	
PVC Ball Check Valve		CV-5	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Sodium Hydroxide (Caustic Soda)
Body	PVC Type 1	**Reference Document**	
Hardware		**Size Range**	<2”
Ball	PVC Type 1	**Body/Valve Ends**	Union with Socket Weld (Note 1)
Type of Ball		**Pressure Rating (psi)**	150 PSI
Disc		**Temperature Rating (deg C)**	
Trim		**Testing**	
Packing		**Operator**	
Shaft		**Actuator**	
Seats	EPDM, PTFE		
Bonnet			
Elastomers			
Cover			
NOTES			
1. No threaded connections shall be permitted.			
ACCEPTABLE PRODUCTS			
Georg Fischer Type 561	Asahi/America Ball Check	Spears Mfg. Company 4529 Series	
Hayward Flow Control			

Check Valve

TYPE OF VALVE		**SYMBOL**	
Ball Check Valve		CV-6	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Sewage Sludge and Solids
Body	Cast Iron (ASTMA126-B) Ductile Iron ASTM A536	**Reference Document**	
Hardware	Stainless Steel Grade 304 or 316	**Size Range**	4" to 24"
Ball	Vulcanized Buna-N (nitrile) rubber cover over hollow metal ball core Ductile Iron ASTM A536, Grade 65-45-12 Vulcanized with Buna-N Rubber	**Body/Valve Ends**	FL per drawings (Note 2), integrally cast 125# inlet and outlet flanges
Type of Ball	Non-Clog, no slam (Note 2)	**Pressure Rating (psi)**	150 PSI
Disc		**Temperature Rating (deg C)**	
Trim	SS	**Testing**	
Packing	Mfr standard	**Operator**	
Shaft	SS	**Actuator**	
Seats	Buna N		
Bonnet		**O-Ring**	Buna-N
Elastomers		**Flanges**	ASME B16.1 Class 125
Cover	Cast Iron (ASTMA126-B) Ductile Iron ASTM A536, Grade 65-45-12		
NOTES			
1. Valve shall be capable of being installed vertically or horizontally.			
2. Valve flow area shall be 100% of the nominal pipeline diameter cross sectional area.			
3. Internal & External Thermosetting Fusion Bonded Epoxy Coating			
ACCEPTABLE PRODUCTS			
AV-TEK Series 4900			

Check Valve

TYPE OF VALVE		**SYMBOL**	
Globe Style Check Valve		CV-7	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1,3)	**Type of Service**	Potable Water
Body	Ductile iron body ASTM A-536 65-45-12	**Reference Document**	-
Type of Disc	Dual guided (top and bottom)	**Size Range**	4" to 24"
Disc	Stainless steel ASTM type 304	**Body/Valve Ends**	FL per drawings (Note 2), 125# ANSI flat face flanges
Guide bushing	304 Stainless Steel	**Pressure Rating (psi)**	150 PSI
Guide pins	Type 304 Stainless Steel	**Temperature Rating (deg C)**	-
Helical or conical spring	ASTM A313 Type 304 Stainless Steel	**Testing**	-
Packing		**Operator**	-
Shaft		**Actuator**	-
Seats	Stainless steel ASTM type 304		
Bonnet			
Elastomers			
Cover			
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Valve shall be capable of being installed vertically or horizontally.			
3. Check valve to have a minimum open area in the body of 110% of the area of the entering or corresponding pipe**.**			
4. Verify the adjacent upstream flange for the adjacent pipe/fitting/valve, internal diameter will adequately support/restrain the check valve internal mechanism within the check valve body. Provide filler flange as necessary.			
ACCEPTABLE PRODUCTS			
Pratt	Milliken	Mueller	Kennedy

Check Valve

TYPE OF VALVE		**SYMBOL**	
Backwater Check Valve		CV-8	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water, Sewage
Body	EPDM	**Reference Document**	
Hardware	SS	**Size Range**	4” to 36”
Ball		**Body/Valve Ends**	FL per drawings (Note 2)
Type of Disc		**Pressure Rating (psi)**	150 PSI, (Note 3)
Disc		**Temperature Rating (deg C)**	
Trim		**Testing**	
Packing		**Operator**	
Shaft		**Actuator**	
Seats			
Bonnet			
Elastomers			
Cover			
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Valve shall be capable of being installed vertically or horizontally.			
3. Valve shall open under 2-inch WC differential pressure.			
ACCEPTABLE PRODUCTS			
Proco 710 (FL) 730 (Plain End)	Red Valve - TideFlex Series 35 or 35-NSF61		

Check Valve

TYPE OF VALVE		**SYMBOL**	
Globe Style Check Valve		CV-9	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1,3)	**Type of Service**	Water
Body	316 Stainless Steel, ASTM A351, GR-CF8M	**Reference Document**	-
Type of Disc	Dual guided (top and bottom)	**Size Range**	4" to 24"
Disc	316 Stainless Steel, ASTM A351, GR-CF8M	**Body/Valve Ends**	FL per drawings (Note 4), 125# ANSI flat face flanges
Guide bushing	316 Stainless Steel	**Pressure Rating (psi)**	150 PSI
Guide pins	316 Stainless Steel	**Temperature Rating (deg C)**	-
Helical or conical spring	ASTM A313 Type 316 Stainless Steel	**Testing**	-
Packing	-	**Operator**	-
Shaft	-	**Actuator**	-
Seats	EPDM		
Bonnet	-		
Elastomers	-		
Cover	-		
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Valve shall be capable of being installed vertically or horizontally.			
3. Check valve to have a minimum open area in the body of 110% of the area of the entering or corresponding pipe**.**			
4. Verify the adjacent upstream flange for the adjacent pipe/fitting/valve, internal diameter will adequately support/restrain the check valve internal mechanism within the check valve body. Provide filler flange as necessary.			
ACCEPTABLE PRODUCTS			
Flomatic	Dezurik		

CORPORATION STOPS

TYPE OF VALVE		**SYMBOL**	
Corporation Stops		CS-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water, Buried.
Body	Bronze	**Reference Document**	AWWA C800
Gasket	EPDM	**Size Range**	¾" to 2"
		Body/Valve Ends	NPT
		Pressure Rating (psi)	300 PSI Liquid, Air or Vacuum Service
		Temperature Rating (deg C)	-
		Testing	Factory Testing shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.
		Operator	T-head fork handle
		Actuator	-
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.			
ACCEPTABLE PRODUCTS			
Ford Meter Box Company	Mueller		

Diaphragm Valve

TYPE OF VALVE		**SYMBOL**	
Diaphragm Valve		DPV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Sodium Hypochlorite <15%,(or Chlorine Gas Solution)
Body	PVC Type 1	**Reference Document**	-
Bonnet	PVC Type 1	**Size Range**	<=4”
Elastomers	PTFE seats or Viton/FKM	**Body/Valve Ends**	Union with Socket Weld or FL (Note 1)
Diaphragm Pattern	Saunders pattern EPDM/PTFE 3-layer with PVDF gas barrier	**Pressure Rating (psi)**	150 PSI
		Temperature Rating (deg C)	-
		Testing	
		Operator	Wheel RS, manual
		Actuator	-
NOTES			
1. Valve shall be capable of being installed vertically or horizontally.			
2. Provide with position indicator.			
3. Diaphragm valves shall be installed in all chlorine solution and chemical feed lines, between the appropriate storage tanks and point of application and as located on the Drawings.			
Georg Fischer	Asahi/America Type-14	Hayward Flow Control	

Diaphragm Valve

TYPE OF VALVE		**SYMBOL**	
Diaphragm Valve		DPV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Ferric Chloride, Aluminum Sulfate, Sodium Bisulfite
Body	PVC Type 1	**Reference Document**	
Bonnet	PVC Type 1	**Size Range**	≤ 2 inch
Elastomers	PTFE Seats, EPDM or Viton /FKM	**Body/Valve Ends**	Union with Socket Weld or FL (Note 1)
Diaphragm Pattern	Saunders pattern with PTFE/EPDM depending on service	**Pressure Rating (psi)**	150 PSI
		Temperature Rating (deg C)	
		Testing	
		Operator	Wheel RS, manual
		Actuator	

NOTES
1. Valve shall be capable of being installed vertically or horizontally.
2. Provide with position indicator.
3. Diaphragm valves shall be installed in all chlorine solution and chemical feed lines, between the appropriate storage tanks and point of application and as located on the Drawings.

ACCEPTABLE PRODUCTS		
Georg Fischer	Asahi/America Type-14	Hayward Flow Control

Diaphragm Valve

TYPE OF VALVE		**SYMBOL**	
Diaphragm Valve		DPV-3	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Sodium Hydroxide (Caustic Soda)
Body	PVC Type 1	**Reference Document**	
Bonnet	PVC Type 1	**Size Range**	≤4 inch
Elastomers	EPDM, PTFE	**Body/Valve Ends**	Union with Socket Weld or Flanged (Note 1)
Diaphragm Pattern	Saunders pattern with EPDM/ PTFE depending on service	**Pressure Rating (psi)**	150 PSI
		Temperature Rating (deg C)	
		Testing	
		Operator	Wheel RS
		Actuator	

NOTES

1. No threaded connections shall be permitted.
2. Provide with position indicator.
3. Diaphragm valves shall be installed in all chlorine solution and chemical feed lines, between the appropriate storage tanks and point of application and as located on the Drawings.

ACCEPTABLE PRODUCTS

Georg Fischer	Asahi/America Type-14	Hayward Flow Control

Flap Valve

TYPE OF VALVE		**SYMBOL**	
Flap Valve		FLV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Liquid (Water or Sewage, Mixed Liquor)
Body/ Flap	Cast iron conforming to ASTM Specifications A126 Class B or Fabricated 304/316 SS	**Reference Document**	-
Hinge Pin	Bronze B62 or 304/316 SS mounts, offset single pivoted hinge, and shall unseat and swing open under unseating pressure. SS	**Size Range**	4" to 24" .
Seat Ring	The flap gate seat ring shall either be rolled into a dove-tailed groove under pressure to make one inseparable unit. The body seat ring shall be threaded and screwed into place in the body. Both gate and body seat ring faces shall be machined to a smooth finish. Bronze B62 or a self-adjusting lip design of EPDM.	**Body/Valve Ends**	ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanges
Wedges/ Seal Faces	Shall bolt on with stainless steel hardware to permit replacement.	**Pressure Rating (psi)**	- As per specification
		Temperature Rating (deg C)	- As per specification
		Testing	- As per specification
		Operator	Handle, with extensions and catch bracket shall be furnished to elevations shown on Plans. As per specifications Orbinox Complies
		Actuator	- As per specification/drawings
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free. Pending			
ACCEPTABLE PRODUCTS			
Kennedy	Clow	M&H	

Orbinox RR or RC		

Gate Valve - Resilient Seat

TYPE OF VALVE		**SYMBOL**	
Resilient Seat Gate Valve		GV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	WOG (Liquid)
Body	Bronze	**Reference Document**	-
Type of Disc	Solid wedge	**Size Range**	<2 ½ inches
Disc	Mfr standard	**Body/Valve Ends**	NPT or FNPT
Trim	Bronze	**Pressure Rating (psi)**	200 WOG operating, 300 design
Packing	Mfr standard	**Temperature Rating (deg C)**	-
Shaft	SS	**Testing**	-
Seats	Mfr standard	**Operator**	Rising Stem
Bonnet	Union	**Actuator**	-
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
ACCEPTABLE PRODUCTS			
Jenkins Bros			

Gate Valve - Resilient Seat

TYPE OF VALVE		**SYMBOL**	
Resilient Seat Gate Valve		GV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1, 3)	**Type of Service**	Liquid
Body	Ductile Iron (Note 2)	**Reference Document**	AWWA C509 and 515
Type of Disc	Full Round Port	**Size Range**	2 to 12 inches
Wedge	Ductile Iron or Cast Iron (Note 2)	**Body/Valve Ends**	FL or MJ per drawings
Trim	Mfr Standard	**Pressure Rating (psi)**	200 operating, 400 design, min.The valve shall seal at full rated pressure with flow from either direction.
Packing	Double O-Ring seal	**Temperature Rating (deg C)**	
Shaft	Mfr Standard	**Testing**	
Seats	Steel Reinforced Rubber, replaceable, or fully encapsulated Rubber	**Operator**	NRS; Handwheel (exposed) or 2-inch square nut (buried).
Bonnet	Mfr Standard	**Actuator**	
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Epoxy coat interior surfaces.			
3. All exposed nuts, bolts and washers shall be zinc-plated. Buries valves shall have stainless steel fasteners.			
ACCEPTABLE PRODUCTS			
Mueller Company 2361 or 2362	Clow 2639 Full Body DI		

Globe Valve

TYPE OF VALVE		**SYMBOL**	
Globe Valve		GL-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Liquid
Body	Bronze, B62	**Reference Document**	-
Type of Disc	Polyurethane, PTFE or (mfr standard)	**Size Range**	<2 ½ inches
Disc	Bronze; composition disc	**Body/Valve Ends**	FNPT, NPT or FL; screwed ends
Trim	Bronze	**Pressure Rating (psi)**	Class 125, 300 lb WOG
Packing	Teflon Impregnated asbestos	**Temperature Rating (deg C)**	3 to 100, design 120
Shaft	Bronze Ring	**Testing**	-
Seats	-	**Operator**	Handwheel, Rising Stem
		Actuator	-
NOTES			
1.			
ACCEPTABLE PRODUCTS			
Jenkins Bros.	Apollo 120T Apollo 127T	Crane	

Needle Valve

TYPE OF VALVE		**SYMBOL**	
Needle		NV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Liquid
Body	316 SS	**Reference Document**	-
Type of Disc	-	**Size Range**	1/8" – 1/2"
Disc	-	**Body/Valve Ends**	FNPT, NPT
Trim	-	**Pressure Rating (psi)**	5000 PSIG
Packing	316 SS Packing Nut	**Temperature Rating (deg C)**	-28 to 37
Shaft	316 SS	**Testing**	-
Seats	-	**Operator**	-
		Actuator	-
NOTES			
ACCEPTABLE PRODUCTS			
Swagelock Series 1R or 18R	Parker		

Knife Gate Valve

TYPE OF VALVE		**SYMBOL**	
Knife Gate Valve		KGV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Liquid (Water or Sewage, Mixed Liquor)
Body/ Frame	304 Stainless Steel ASTM A351 CF8/ or Cast Iron	**Reference Document**	
Disc/ Gate	304 Stainless Steel ASTM A240	**Size Range**	4" to 24"
Yoke	304 Stainless Steel CF8	**Body/Valve Ends**	ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanges; heavy duty flanged type; must provide positive seal under both seating and unseating head conditions.
Trim/ Fasteners	18-8 SS	**Pressure Rating (psi)**	150
Stem/ Stem Nut/ Seat ring	304 Stainless Steel ASTM A276	**Temperature Rating (deg C)**	
Packing	Teflon w/ PTFE anti-extrusion plate 500˚F (260˚C)	**Testing**	
Gland	304 Stainless Steel ASTM A351 CF8	**Operator**	Non-Rising Stem (Note 2); handwheel - or 2" nut
Yoke Sleeve	Aluminum Bronze or Brass	**Actuator**	
Seat	NBR or EPDM		

NOTES

1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.
2. Valves shall be furnished complete with non-rising stainless-steel extension stem and indicating floor stand, or wall bracket, or 2-inch operating nut, depending on location, as shown on the Drawings. Stem guides shall be provided as recommended by the manufacturer.

ACCEPTABLE PRODUCTS		
Dezurik KGN	Red Valve Series D Slurry KGV	Approved Equal
Henry Pratt		

Mud Valve

TYPE OF VALVE		**SYMBOL**	
Mud Valve		MV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Liquid (Water or Sewage, Mixed Liquor)
Body/ Frame	316L Stainless Steel	**Reference Document**	-
Disc/ Gate	316L Stainless Steel	**Size Range**	4”-6”
Yoke	316L Stainless Steel	**Body/Valve Ends**	ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanges; heavy duty flanged type; must provide positive seal under both seating and unseating head conditions.
Trim/ Fasteners	316L Stainless Steel	**Pressure Rating (psi)**	150
Stem/ Stem Nut/ Seat ring	Stem: 316L Stainless Steel Stem Nut: Bronze Seat ring shall be tapered and have a machined seating face that mates with the seat to provide a drip tight seal. Stem threads shall be machined cut modified acme threads.	**Temperature Rating (deg C)**	-
Packing	Bronze to Bronze	**Testing**	-
Plug	Plug: 316L Stainless Steel Plug Seat: Seamless Buna-N	**Operator**	Non-Rising Stem (Note 2); handwheel
Yoke	316L Stainless Steel	**Actuator**	-

NOTES
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.
2. Valves shall be furnished complete with non-rising stainless steel extension stem and indicating floor stand, or wall bracket, or 2-inch operating nut, depending on location, as shown on the Drawings. Stem guides shall be provided as recommended by the manufacturer.

ACCEPTABLE PRODUCTS		
Troy Valve	Trumbull	Waterman Model MV-11

Pressure Regulating Valve

TYPE OF VALVE		**SYMBOL**	
Pressure Regulating Valve (Pressure Reducing)		PRV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Water
Body	Cast Bronze, Brass	**Reference Document**	CSA or ASME Certification
Spring	Stainless Steel	**Size Range**	<3”
Elastomers	-	**Body/Valve Ends**	NPT, FNPT (Note 3)
		Pressure Rating (psi)	150 PSI (Note 2)
		Temperature Rating (deg C)	-
		Testing	-
		Operator	Adjustment nut/screw
		Actuator	-

NOTES
1. Valve shall be NSF 61certified for potable water applications– Lead free.
2. Valve shall be adjustable with range suitable for the installation.
3. A strainer shall be provided ahead of all PCVs and PRVs

ACCEPTABLE PRODUCTS		
Watts	Mueller	Apollo 36ELF (1/2” – 1”)
Apollo 36H (1 ¼” – 3”)		

Pressure Regulating Valve

TYPE OF VALVE		**SYMBOL**	
Pressure Regulating Valve (Backpressure and Pressure Relief)		PRV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Water, Chemical – Sodium Hypochlorite <15%, (or Chlorine Gas Solution)
Body	PVC Type 1 or Polypropylene	**Reference Document**	-
Seat Ring	-	**Size Range**	≤3”
Elastomers	PTFE seats or Viton	**Body/Valve Ends**	Union with Socket Weld (Note 1)
		Pressure Rating (psi)	150 PSI
		Temperature Rating (deg C)	140 F PVC; PP 195 F
		Testing	-
		Operator	Adjustment nut/screw
		Actuator	-
NOTES			
1. Valve shall have threaded double-union body that can be removed from the line without disengaging the end connections.			
ACCEPTABLE PRODUCTS			
Grifco G Series	Plastomatic	Asahi/America, Inc	
Hayward Flow Control			

Pressure Regulating Valve

TYPE OF VALVE		**SYMBOL**	
Pressure Regulating Valve (Backpressure and Pressure Relief)		PRV-3	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Ferric Chloride, Sodium Bisulfite, Aluminum Sulfate, Sodium Hydroxide (Note 2), or Citric Acid
Body	PVC Type 1 or Polypropylene	**Reference Document**	-
Seat Ring	-	**Size Range**	<2”
Elastomers	PTFE Seats, EPDM or Viton (Note 2)	**Body/Valve Ends**	Union with Socket Weld (Note 1)
		Pressure Rating (psi)	150 PSI
		Temperature Rating (deg C)	140 F PVC; PP 195 F
		Testing	-
		Operator	Screw Adjust
		Actuator	-
NOTES			
1. Valve shall have threaded double-union body that can be removed from the line without disengaging the end connections.			
2. When used with sodium hydroxide, valve elastomers shall be PTFE only.			
ACCEPTABLE PRODUCTS			
Griffco G Series	Plastomatic	Hayward Flow Control	

Pressure Regulating Valve

TYPE OF VALVE		**SYMBOL**	
Pressure Regulating Valve (Backpressure and Pressure Relief)		PRV-4	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Chemical – Sodium Hydroxide (Caustic Soda)
Body	316 SS	**Reference Document**	-
Seat Ring	-	**Size Range**	<2”
Elastomers	PTFE Diaphragm	**Body/Valve Ends**	Union with Socket Weld (Note 1,2)
		Pressure Rating (psi)	150 PSI
		Temperature Rating (deg C)	300 F
		Testing	-
		Operator	Screw Adjust
		Actuator	-

NOTES
1. Valve shall have threaded double-union body that can be removed from the line without disengaging the end connections.
2. No threaded ends, socket weld or Flanged only.

ACCEPTABLE PRODUCTS		
Asahi/America, Inc.	Griffco G Series	Plastomatic

Pinch Valve

TYPE OF VALVE		**SYMBOL**	
Pinch Valve		PIV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS**	**Type of Service**	Sewage, Water, Sludge, Mixed Liquor
Body	Ductile Cast Iron. The valve face-to-face dimensions shall be as given in ASME/ANSI B16.10. Open Body designs shall not be permitted.	**Reference Document**	-
Stem/ Pinch Mechanism	The pinch mechanism shall be double acting, centerline closure. The mechanism shall be supported in the valve body. (Note 3).	**Size Range**	4" to 24"
Sleeve	Buna-N inner tube in contact with the process, a high strength nylon, polyester or Kevlar fabric as recommended by the manufacturer for the conditions. The layers shall be vulcanized together to for a tough, maintenance free sleeve. (Note 1)	**Body/Valve Ends**	ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanges
Sleeve Trim	Flange bolts shall not penetrate the sleeve as to retain its position allowing for in-line tube change, without removing the entire valve from the pipeline. No recalibration should be required in sleeve replacement. All internal valve metal parts are to be completely isolated from the process fluid by the sleeve.	**Pressure Rating (psi)**	Throttling Service 150 PSI
		Temperature Rating (deg C)	-
		Testing	-
		Operator	-
		Actuator	Motorized with manual override. Electric actuators as shown on the plans and as specified in Division 16. (Note 2)
NOTES			
1. The port areas shall be 100% of the full pipe area at the valve ends and have inlet and outlet cones as identified on the drawings.			

2. For below-grade applications (inside vaults), a torque tube shall be fitted to the body of the valve via a mounting plate. The tube shall extend from the valve to 36” above grade level, providing protection for the operating stem and supporting the motorized actuator. Coordinate actuator mounting stem/plate with actuator mfr.		
3. The pinch mechanism shall be adjustable for stroke without removing the valve from the line.		
4. The pinch valve and actuator assembly shall be integrated, adjusted, tested and have start-up services performed by an authorized manufactures representative.		
ACCEPTABLE PRODUCTS		
Red Valve Series 5200E or Series 5200ED	RF Valve – Enclosed Body	

Plug Valve

TYPE OF VALVE	**SYMBOL**
Eccentric Plug Valve	PV-1

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Sewage, Sludge, Scum
Body	ASTM A126 Class B cast iron	**Reference Document**	ANSI/AWWA C517 Eccentric Plug Valves
Type of Plug	Eccentric, non-lubricated	**Size Range**	3" TO 36"
Plug	Standard and 3-way plug valves shall have resilient plug facings shall be of neoprene suitable for use with sewage, sludge or scum. (Note 4)	**Body/Valve Ends**	ANSI B16.1 125/ B16.5 150# FL or MJ or screwed as shown on drawings (Note 3)
Packing/Sealing	1)4" and larger valves shall be re-packable and adjustable packing without removing the bonnet 2) Lip Seal	**Pressure Rating (psi)**	150 PSI
Trim	SS	**Temperature Rating (deg C)**	300 F
Shaft	SS	**Testing**	-
Seats	Raised seats. Seats in 3" and larger valves shall have a welded-in overlay of high nickel content on all surfaces contacting the plug face. (Note 4, 5)	**Operator**	Geared (Note 2)
Bearings	Body: 316L SS Sealed, permanently lubricated in upper and lower stem journals; Thrust: PTFE	**Actuator**	Automated pneumatic or electric motor actuator as indicated on the plans and specifications.
Bonnet	Bolted, ASTM A126 Class B cast iron		

NOTES

1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.
2. Valves shall have gear actuators and tee wrenches, extension stems, floor stands, chain-wheels, etc., as required or indicated on the Plans. Quarter turn lever actuators required if specifically noted on the Plans. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator allowing for submerged or buried service. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators, if required, shall clearly indicate valve position, and an adjustable stop shall be provided to set closing torque.
3. Flanges of valves through 12" shall have face-to-face dimensions of standard gate valves.
4. Port areas of valves shall be a minimum of 80% of full pipe area. Port areas of valves shall be round port with 100% of full pipe areas where indicated on plans.
5. ***Valves installed in sludge lines shall be installed with the seat on the upstream side and shall be designed for bi-directional service.***

ACCEPTABLE PRODUCTS

Dezurik	Pratt	Milliken	Val-Matic

- All exposed nuts, bolts, springs and washers shall be zinc-plated.
- Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers shall be stainless steel.

Shear Gate Valve

TYPE OF VALVE		**SYMBOL**	
Shear Gate Valve		SGV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1, 2)	**Type of Service**	Liquid (Water or Sewage, Mixed Liquor)
Body	Cast Iron, ASTM 126B	**Reference Document**	-
Mounts	Bronze	**Size Range**	4" to 12"
Seat Wedges/ Seal Faces	Cast Iron, ASTM 126B, replaceable. Mounted with SS hardware.	**Body/Valve Ends**	ANSI B16.1, Class 125/ANSI B16.5, Class 150 flanged end
Disc	Cast Iron, ASTM 126B	**Pressure Rating (psi)**	30 ft WC
Seat rings, disc ring, hinge bolt and hinge nut	Bronze, B62.	**Temperature Rating (deg C)**	-
Lift rods	¾" diameter carbon steel. Shall be used to manually raise and lower the Shear Gate disc from a position above the gate.	**Testing**	-
		Operator	Handle, with extensions shall be furnished to elevations shown on Plans.
		Actuator	-
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified– Lead free.			
2. Full opening, circular port.			
ACCEPTABLE PRODUCTS			
Clow	M&H		

Solenoid Valve

TYPE OF VALVE		**SYMBOL**	
Solenoid Valve		SV-1	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water, Filtered Process Water (free chlorine <10 ppm)
Body	PVC	**Reference Document**	
Seals	FKM	**Size Range**	½" to 2"
		Body/Valve Ends	NPT/FNPT
		Pressure Rating (psi)	150
		Temperature Rating (deg C)	
		Testing	
		Operator	
		Actuator	Solenoid magnet (Note 2)
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.			
2. Valve configuration data (normally (fail) closed, or normally (fail) open) shall be submitted to Engineer prior to ordering.			
ACCEPTABLE PRODUCTS			
Plast-O-Matic Z-Cool series (voltage per electrical requirements).			

Solenoid Valve

TYPE OF VALVE		**SYMBOL**	
Solenoid Valve		SV-2	
VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	**MATERIALS** (Note 1)	**Type of Service**	Water, Filtered Process Water (free chlorine <10 ppm); Class I, Division I hazardous area
Body	Stainless Steel	**Reference Document**	
Diaphragm	FKM	**Size Range**	½" to 2"
O-rings	FKM	**Body/Valve Ends**	NPT/FNPT
		Pressure Rating (psi)	150
		Temperature Rating (deg C)	
		Testing	
		Operator	
		Actuator	Solenoid magnet (Note 2)
NOTES			
1. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.			
2. Valve configuration data (normally (fail) closed, or normally (fail) open) shall be submitted to Engineer prior to ordering.			
ACCEPTABLE PRODUCTS			
Burkert Type 5282 (voltage per electrical requirements).			

END OF SECTION

TECHNICAL SECTION 4: SITEWORK
(LAGOON DECOMMISSIONING)

FOR

Town of Palisade, Colorado
Sewer Transfer Line

December 2025

Prepared by: J-U-B Engineers, Inc.
81-23-029

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J·U·B ENGINEERS, INC.

Town of Palisade Sewer Transfer Project
Lagoon Waste Disposal Plan

December 2025

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Appendix C – Paint Filter Test Procedure

1. Sludge Testing Requirements Prior to Disposal

Table summarizes the regulations and testing required for landfill disposal. The testing is required to show whether the sludge is considered a non-hazardous solid waste for 40 CFR Part 258 solid waste regulations.

Table 1 – Sludge Pollutant Testing for Landfill Disposal

	Landfill
Regulations	40 CFR Part 258
Pollutants to Test	8 Metals (toxicity) Flash Point (ignitability) pH (corrosivity)
Additional Tests	Paint Filter Test
# of Samples	1 = Pond 1: one (1) composite (2 subsamples/composite) at each depth for metals 1 = Pond 2: one (1) composite (2 subsamples/composite) at each depth for metals 1 = Pond 3: one (1) composite (2 subsamples/composite) at each depth for metals 1 = Pond 4: one (1) composite (2 subsamples/composite) at each depth for metals Each load to the landfill or 7 representative samples (Paint Filter Test)

2. Disposal Procedures

Disposal Procedures:

1) Collect sludge samples for metals, flash point, and pH. See **Appendix A** "Sludge Sampling Procedure."
2) Confirm that results are below the toxicity, ignitability, and corrosivity limits to be classified as non-hazardous solid waste for each pollutant in **Table** . If results exceed the allowable limits then alternative disposal methods will be required and landfill disposal will not be permitted.

Table 2 – Toxicity, Ignitability, and Corrosivity Characteristics of Non-Hazardous Solids Waste

Characteristic	Pollutant	Allowable Limits
Toxicity (A)	Arsenic	5 mg/L
	Barium	100 mg/L
	Cadmium	1 mg/L
	Chromium	5 mg/L
	Copper (B)	NA
	Lead	5 mg/L
	Mercury	0.2 mg/L
	Selenium	1 mg/L
	Silver	5 mg/L
Ignitability (B)	Flash Point	greater than 60°C (140°F)
Corrosivity (C)	pH	$2 \geq pH \leq 12.5$

3) Dispose of materials in accordance with the "Sludge Disposal and Spill Response Procedures" in **Appendix B.**
4) Remove and haul the solids.
   IMPORTANT: Confirm that no free liquids are present in the bulk solids before hauling any solids to the landfill by performing the Paint Filter Test on representative samples (**Appendix C**)
   a) Remove and dispose of the pond appurtenances
   b) Remove the sludge from the ponds
   c) Remove and dispose of the liners and geotextiles

Appendices

Appendix A – Sludge Sampling Procedure
Appendix B – Sludge Disposal Procedure and Spill Prevention and Response Plan
Appendix C – Paint Filter Test Procedure

Appendix A

Sludge Sampling Procedure

Sludge Sampling Procedure

Sampling Overview:
Collect representative samples from the entire lagoon surface area at a depth of 6" for the required analyses. Collect four (4) composite samples for metals, flash point, and pH.

Sampling Instructions:
1) Wearing nitrile gloves and using a stainless steel sampling probe, collect subsamples at the required depth and location as shown on **Sheet C-701 of the Project Plans**.
2) Mix equal volumes of each subsample core thoroughly in a clean plastic pail to obtain a composite sample for each pond.
3) Store composite samples in "zip lock" bags and label appropriately with location, depth, and date (e.g., "Pond 1 @ depth X, (mm/dd/yy)").
4) Transport samples via 2-day shipping to a testing laboratory approved by the Owner/Engineer.
5) Instruct the lab to analyze the samples as shown on an Owner/Engineer approved Chain of Custody form.

Important: Notify the laboratory seven days ahead of time that sludge will be arriving for analysis.

Appendix B

Sludge Disposal and Spill Response Procedures

SLUDGE DISPOSAL AND SPILL RESPONSE PROCEDURES
Courtesy of the EIRWWA Oxbow Water Reclamation Facility

This spill response plan accompanies the one-time landfill disposal plan of the existing sludge at Town of Palisade's WWTF Lagoons.

This sludge is not a hazardous material. The sludge also passes the Paint Filter Liquid Test indicating that there are no free liquids.

TYPICAL CHARACTERIZATION

Appearance	Brown/Black dried solids
Free Liquid	None
pH	Non-corrosive
Metals Content	Meets 40 CFR Part 261.24 Regulations

HANDLING PRACTICES[1]

Sludge has been treated and dried to reduce pathogens. Nonetheless, there is the potential for exposure to pathogenic microorganisms. Major routes of infection are ingestion, inhalation and direct contact. Good, common sense, personal hygiene and work habits provide adequate protection for workers handling sludge.

HAZARD POTENTIAL

Sludge is not combustible under ordinary circumstances. If stored in airtight containers for an extended period, methane gas may be produced which could ignite in the presence of a spark or open flame. Extinguish with dry chemical, water spray or foam. Avoid use of open flames in confined areas and around sealed transport containers. Vent confined areas and transport containers if sludge have been stored for any significant length of time.

Hydrogen sulfide may also be generated in sufficient quantities to be a hazard in enclosed areas such as tarpped transport containers. Hydrogen sulfide gas, which smells like rotten eggs, can be toxic. Exposure can be avoided by removing the container tarp prior to unloading and discharging as much material as possible prior to employees entering the container.

GENERATOR/ORIGINATOR DATA

Generator/Originator	Town of Palisade Brentwood WWTF
Address	Brentwood Drive
City, State, Zip Code	Palisade, CO 81526
Phone Number	(970) 464-5602

The following landfills accept sludge from the Palisade Brentwood WWTF.

LANDFILL DATA

Landfill	Mesa County Solid Waste Management Facility
Address	3071 US-50
City, State, Zip Code	Grand Junction, CO 81503
Phone Number	(970) 242-7467
Haul Distance	13 miles (26 miles round trip)

SLUDGE HAULER SPILL RESPONSE PROCEDURES[2]

1. General

A. Sludge is non-hazardous and non-toxic. If a spill occurs, there is no need for special equipment or emergency protocol beyond that outlined in this procedure. Sludge is primarily processed solids produced by sewage treatment plants.

B. Sludge spilled onto pavement poses a potential road hazard because it can create wet, slick surfaces for motor vehicles, and/or can obstruct traffic flow. If Sludge remains on the surface for a sufficient time, it could be a source of potential contamination of nearby storm drains, waterways, or ground water. Sludge should be thoroughly removed so that no significant residue remains to be washed into any storm drain or waterway by surface water. All spilled Sludge must be returned to the trailer from which it spilled, or be loaded into another appropriate transport vehicle.

2. Sludge Characteristics and Personal Hygiene Procedures

A. Sludge is processed organic residual solids from domestic sewage treatment, containing nitrogen, phosphorus, trace metals, and some pathogenic (disease-causing) organisms. Sludge being transported is dry and dirt-like, with solids estimated at 45% solids or greater.

B. Personnel cleaning up a spill of sludge should:

- Wear gloves for shoveling, sweeping or handling sludge.
- Not eat, drink, smoke or chew while working directly with sludge
- Wash hands (and as necessary all other exposed parts of the body) with waterless hand cleaner, or soap and water, following spill clean-up and prior to eating, drinking, smoking or chewing.

3. Over-the-Road Spill Response Procedures

A. Park the truck on the side of the road and place traffic cones, reflectors and/or flares to divert traffic around the spill. Remain with the truck and spilled materials, unless it is necessary to leave temporarily to contact emergency services.

B. Drivers shall notify Matt Filla as soon as possible by telephone (307) 343-3440. Give the location and amount of sludge spilled. Also notify Law Enforcement, if the spill has occurred on a public right of way.

C. Inform the authorities that you are hauling sludge which is non-hazardous and non-toxic.

D. Cooperate with the authorities, assist with traffic control and clean-up.

E. Do not leave the scene of any spill, even a small one, until it is cleaned up. You may clean up small spills first and then report the spill.

4. Spill Response Procedures

A. Load spilled sludge back into the vehicle if it is operable. If the vehicle is disabled, the spill must be loaded into an alternate vehicle.

B. Spilled sludge must be prevented from migrating off the incident site, into storm drains, or into surface waters. This is especially important if an incident occurs in rain conditions. Sludge spills may be diked or controlled with sand, sand bags, straw, absorbents, or other blocking material.

C. Two people working with shovels can load a small spill into a vehicle. A large spill must be loaded into the vehicle by an appropriate loader. The scene coordinator is best suited to choose the appropriate loading option to deal with the spill, based on equipment availability and spill size.

D. After the spill has been loaded, the incident site must be cleaned. Spills may be cleaned by sweeping the site free of remaining debris and covering the spill area with dry lime (disinfectant) and sand. Do not wash off tools or trucks at the spill location; return tools and trucks to the wastewater treatment plant for cleaning.

E. Cleaned up spills should either be taken to the original destination or to a landfill permitted to receive sludge. They may also be accepted by the originating sewage treatment plan.

F. Spill response drills should be conducted periodically.

Appendix C

Paint Filter Test Procedure

METHOD 9095B

PAINT FILTER LIQUIDS TEST

1.0 SCOPE AND APPLICATION

1.1 This method is used to determine the presence of free liquids in a representative sample of waste.

1.2 The method is used to determine compliance with 40 CFR 264.314 and 265.314.

2.0 SUMMARY OF METHOD

2.1 A predetermined amount of material is placed in a paint filter. If any portion of the material passes through and drops from the filter within the 5-min test period, the material is deemed to contain free liquids.

3.0 INTERFERENCES

3.1 Filter media were observed to separate from the filter cone on exposure to alkaline materials. This development causes no problem if the sample is not disturbed.

3.2 Temperature can affect the test results if the test is performed below the freezing point of any liquid in the sample. Tests must be performed above the freezing point and can, but are not required to, exceed room temperature of 25 ^{o}C.

4.0 APPARATUS AND MATERIALS

4.1 Conical paint filter -- Mesh number 60 +/- 5% (fine meshed size). Available at local paint stores such as Sherwin-Williams and Glidden.

4.2 Glass funnel -- If the paint filter, with the waste, cannot sustain its weight on the ring stand, then a fluted glass funnel or glass funnel with a mouth large enough to allow at least 1 in. of the filter mesh to protrude should be used to support the filter. The funnel should be fluted or have a large open mouth in order to support the paint filter yet not interfere with the movement, to the graduated cylinder, of the liquid that passes through the filter mesh.

4.3 Ring stand and ring, or tripod.

4.4 Graduated cylinder or beaker -- 100-mL.

5.0 REAGENTS

5.1 None.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

A 100-mL or 100-g representative sample is required for the test. If it is not possible to obtain a sample of 100 mL or 100 g that is sufficiently representative of the waste, the analyst may use larger size samples in multiples of 100 mL or 100 g, i.e., 200, 300, 400 mL or g. However, when larger samples are used, analysts shall divide the sample into 100-mL or 100-g portions and test each portion separately. If any portion contains free liquids, the entire sample is considered to have free liquids. If the sample is measured volumetrically, then it should lack major air spaces or voids.

7.0 PROCEDURE

7.1 Assemble test apparatus as shown in Figure 1.

7.2 Place sample in the filter. A funnel may be used to provide support for the paint filter. If the sample is of such light bulk density that it overflows the filter, then the sides of the filter can be extended upward by taping filter paper to the inside of the filter and above the mesh. Settling the sample into the paint filter may be facilitated by lightly tapping the side of the filter as it is being filled.

7.3 In order to assure uniformity and standardization of the test, material such as sorbent pads or pillows which do not conform to the shape of the paint filter should be cut into small pieces and poured into the filter. Sample size reduction may be accomplished by cutting the sorbent material with scissors, shears, a knife, or other such device so as to preserve as much of the original integrity of the sorbent fabric as possible. Sorbents enclosed in a fabric should be mixed with the resultant fabric pieces. The particles to be tested should be reduced smaller than 1 cm (i.e., should be capable of passing through a 9.5 mm (0.375 inch) standard sieve). Grinding sorbent materials should be avoided as this may destroy the integrity of the sorbent and produce many "fine particles" which would normally not be present.

7.4 For brittle materials larger than 1 cm that do not conform to the filter, light crushing to reduce oversize particles is acceptable if it is not practical to cut the material. Materials such as clay, silica gel, and some polymers may fall into this category.

7.5 Allow sample to drain for 5 min into the graduated cylinder.

7.6 If any portion of the test material collects in the graduated cylinder in the 5-min period, then the material is deemed to contain free liquids for purposes of 40 CFR 264.314 and 265.314.

8.0 QUALITY CONTROL

8.1 Duplicate samples should be analyzed on a routine basis.

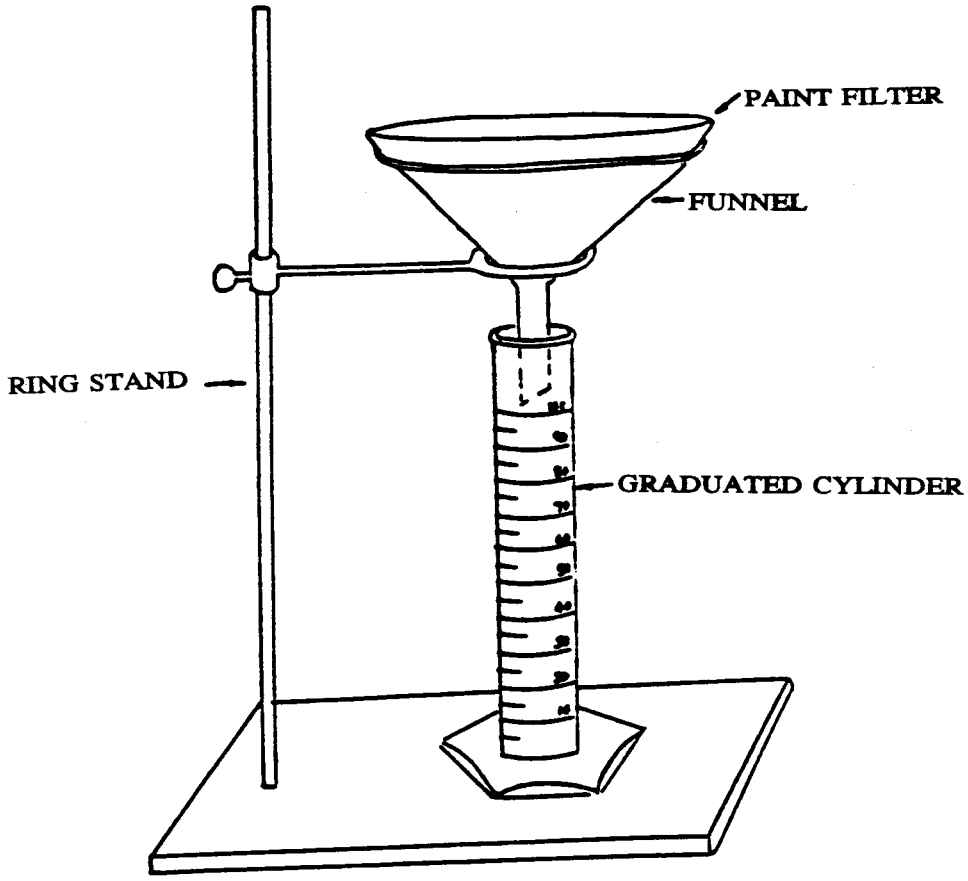
9.0 METHOD PERFORMANCE

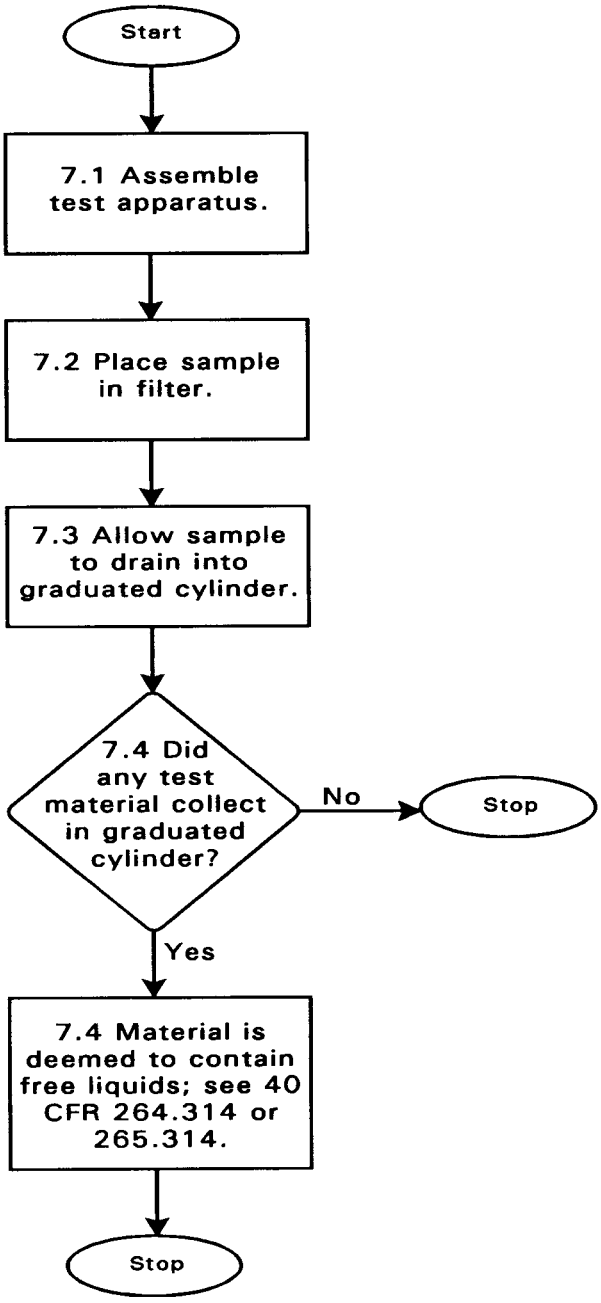
9.1 No data provided.

10.0 REFERENCES

10.1 None provided.

FIGURE 1
PAINT FILTER TEST APPARATUS




Start
7.1 Assemble test apparatus.
7.2 Place sample in filter.
7.3 Allow sample to drain into graduated cylinder.
7.4 Did any test material collect in graduated cylinder?
No
Stop
Yes
7.4 Material is deemed to contain free liquids; see 40 CFR 264.314 or 265.314.
Stop

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