

SPECIFICATIONS AND CONTRACT DOCUMENTS

FOR

MOUNT PLEASANT CITY CORPORATION

Mt Pleasant Lagoon Improvements Project

September 2025

**J-U-B ENGINEERS, Inc.
93-24-009**



J-U-B ENGINEERS, INC.

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**MOUNT PLEASANT CITY
Mt Pleasant Lagoon Improvements Project**

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ADVERTISEMENT FOR BIDS
MOUNT PLEASANT CITY
MOUNT PLEASANT, UTAH 84647
MT PLEASANT LAGOON IMPROVEMENT PROJECT

General Notice

MOUNT PLEASANT CITY (Owner) is requesting Bids for the construction of the following Project:

MT PLEASANT LAGOON IMPROVEMENTS PROJECT
93-24-009

Bids for the construction of the Project will be received at the **Mount Pleasant City Hall, Recorder's Office – Room 227** located at **115 W Main St, Mount Pleasant, Utah, 84647**, until **Thursday, October 9th** at **2pm** local time. At that time the Bids received will be **publicly** opened and read.

The Project includes the following Work:

The Mt Pleasant Lagoon Improvements Project (Hereafter referred to as "Project") consists of lining lagoon 3 and construction of a new headworks building, including installation of mechanical screens, odor control provisions, HVAC and plumbing, electrical, instrumentation, site work, yard piping, septage receiving station, and all other equipment and infrastructure needed to make the new facilities complete and operational. Project is in Sanpete County, Utah.

Bids are requested for the following Contract: **Mt Pleasant Lagoon Improvements Project**

Obtaining the Bidding Documents

Information and Bidding Documents for the Project can be found at the following designated website:

www.questcdn.com

Bidding Documents may be downloaded from the designated website, document #9873471 as electronic portable document format (pdf) files for a non-refundable fee of \$22.00. Prospective Bidders shall register with the designated website as a plan holder. 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 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.

Pre-bid Conference

A pre-bid conference for the Project will be held on **Tuesday, September 23rd** at **2pm** at **115 W Main St, Mount Pleasant, Utah, 84647**. Attendance at the pre-bid conference is encouraged but not required.

Schedule Recap:

Item	Date
Bid Advertisement	Tuesday, September 9, 2025
Prebid	Tuesday, September 23, 2pm
Last day for Questions	Friday, October 3, 2025
Bids Due	Thursday, October 9, 2025, 2pm
Substantial Completion	TBD. Estimated October 9, 2026
Final Completion	TBD. Estimated November 9, 2026

Instructions to Bidders.

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.

This Advertisement is issued by:

Owner: **Mount Pleasant city**
By: **Colter Allen**
Title: **Public Works Director**
Date: **September 9, 2025**

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.

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 established 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. Registered plan holders will receive Addenda issued by Owner.
- 2.04 Bidder may register as a plan holder and obtain complete sets of Bidding Documents, in the number and format stated in the Advertisement or invitation to bid, from the Issuing Office. Bidders may rely that sets of Bidding Documents obtained from the Issuing Office are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.
- 2.05 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as plan holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding Documents or other documents obtained from plan rooms, or for a Bidder's failure to obtain Addenda from a plan room.
- 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 Adobe Acrobat Reader Version **2025** or later. It is the intent of the

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.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, after submitting its Bid and within **7** days of Owner's request, Bidder must submit the following information:
 - A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
 - B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.
 - C. Bidder's state or other contractor license number, if applicable.
 - D. Subcontractor and Supplier qualification information.
 - E. Other required information regarding qualifications.
- 3.02 Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4—PRE-BID CONFERENCE

- 4.01 A non-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. Bidders are encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.
- 4.02 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions

at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

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

5.01 *Site and Other Areas*

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

5.02 *Existing Site Conditions*

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

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
 - a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.
 - b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.
 - c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
2. Owner will make 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. *Geotechnical Baseline Report/Geotechnical Data Report*: The Bidding Documents contain a Geotechnical Baseline Report (GBR) and Geotechnical Data Report (GDR).
 - a. As set forth in the Supplementary Conditions, the GBR describes certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations ("Baseline Conditions"). The GBR is a Contract Document.
 - b. The Baseline Conditions in the GBR are intended to reduce uncertainty and the degree of contingency in submitted Bids. However, Bidders cannot rely solely on

the Baseline Conditions. Bids should be based on a comprehensive approach that includes an independent review and analysis of the GBR, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are baselined.

- c. Nothing in the GBR is intended to relieve Bidders of the responsibility to make their own determinations regarding construction costs, bidding strategies, and Bid prices, nor of the responsibility to select and be responsible for the means, methods, techniques, sequences, and procedures of construction, and for safety precautions and programs incident thereto.
 - d. As set forth in the Supplementary Conditions, the GDR is a Contract Document containing data prepared by or for the Owner in support of the GBR.
- 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. In addition to the documents regarding existing Site conditions referred to in Paragraph 5.02.A, the following other documents relating to conditions at or adjacent to the Site are known to Owner and made available to Bidders for reference:
 - 1. **None**Owner will make copies of these other Site-related documents available to any Bidder on request.
- B. Owner has not verified the contents of these other Site-related documents, and Bidder may not rely on the accuracy of any data or information in such documents. Bidder is responsible for any interpretation or conclusion Bidder draws from the other Site-related documents.
- C. The other Site-related documents are not part of the Contract Documents.
- D. Bidders are encouraged to review the other Site-related documents, but Bidders will not be held accountable for any data or information in such documents. The requirement to review and take responsibility for documentary Site information is limited to information in (1) the Contract Documents and (2) the Technical Data.
- 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 prebid conference. Maps to the Site will be made available at the prebid conference.
- C. Bidders visiting the Site are required to arrange their own transportation to the Site.

- D. All access to the Site other than during a regularly scheduled Site visit must be coordinated through the following Owner or Engineer contact for visiting the Site: **Colter Allen, (435) 201-9184**. Bidder must conduct the required Site visit during normal working hours.
- E. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- F. 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.
- G. 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.
- H. 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, Agreement*

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

ARTICLE 7—INTERPRETATIONS AND ADDENDA

- 7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.
- 7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows:
- A. **Gary Vance at J-U-B Engineers, Inc. Email: gvance@jub.com**
- 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.
- 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

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.

ARTICLE 10—SUBSTITUTE AND “OR EQUAL” ITEMS

- 10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 10.02 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 11.02 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within five days after Bid opening:
- A. **Liner Installation**
 - B. **Electrical**
- 11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 11.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers.

Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

- 12.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form must be completed 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.
- 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. The corporate seal must be affixed and attested by the corporate secretary or an assistant corporate secretary.
- 12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.
- 12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.
- 12.06 A Bid by an individual must show the Bidder’s name and official address.
- 12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.08 All names must be printed in ink below the signatures.
- 12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
- 12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.

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

ARTICLE 13—BASIS OF BID

13.01 *Base Bid with Alternates*

- A. Bidders must submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- B. In the comparison of Bids, alternates will **not be used for the selection of the lowest apparent bidder.**

13.02 *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.

13.03 *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.

ARTICLE 14—SUBMITTAL OF BID

- 14.01 The Bidding Documents include one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 2 of the Bid Form.
- 14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must be enclosed in a plainly marked package with the

Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the Advertisement.

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

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

- 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 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

- 18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.
- 18.02 Owner 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 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.

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. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner will announce to all bidders a “Base Bid plus alternates” budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.

C. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.

1. The method for calculating the lowest bid for comparison will be the summation of the Bid price shown in the Bid Form plus the product of the Bidder-specified time of Substantial Completion in calendar days times the rate for liquidated damages [**or other Owner-designated daily rate**] in dollars per day.

2. This procedure is only used to determine the lowest bid for comparison and contractor selection purposes. The Contract Price for compensation and payment purposes remains the Bid price shown in the Bid Form.

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.

ARTICLE 19—BONDS AND INSURANCE

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

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

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

ARTICLE 20—SIGNING OF AGREEMENT

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

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:

Mount Pleasant City Hall – Recorder’s Office

115 W Main Street

Mount Pleasant, Utah, 84647

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. 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;
- C. 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;
- D. Required Bidder Qualification Statement with supporting data; and

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

3.01 *Base Bid*

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

ARTICLE 1—SCHEDULE A – BASE BID

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Price
A1	Mobilization, PM, OH&P	1	LS	\$	\$
A2	Lagoon 3 Geomembrane Liner	1	LS	\$	\$
A3	Lagoon 3 Cushion Layer, 6” Sand	1	LS	\$	\$
A4	Septage Receiving Station and Tank	1	LS	\$	\$

A5	Headworks Building	1	LS	\$	\$
TOTAL OF SCHEDULE A (BASE BID)					

B. 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.

3.02 *Major Equipment Items Alternates*

Certain items of major equipment to be provided under this Contract are tabulated in the Schedule of Manufacturers and Suppliers of Major Equipment and Material Items. In connection with the tabulation of major items of equipment included in the lump sum base bid, the following shall apply:

- A. The lump sum bid shall include the installed prices from those manufacturers listed by the Owner as "Base Bid."
- B. Bidder may include prices for listed alternate manufacturers or add additional manufacturers with corresponding prices, but only the manufacturers listed by the Owner as "Base Bid" will be considered in determining the low bid. Listing of alternate equipment is optional and will not result in submitting a non-responsible bid if none is entered.
- C. The Owner may select the Base Bid equipment or items of equipment of any alternate manufacturer listed, at Owner's discretion.
- D. After the Date of Agreement and prior to the selection of the major equipment items, the Contractor, if requested by the Engineer, shall provide information in sufficient detail to allow the Owner and the Engineer to determine whether or not the proposed alternate equipment is equivalent to that specified. The selection of any alternate equipment by the Owner does not relieve the Contractor of his/her responsibility to meet the requirements of the Contract Documents and Specifications.
- E. Items of equipment selected by the Owner shall be installed at a contract price equal to the Base Bid lump sum adjusted by the add or deduct shown for the items selected by the Owner if different from the Base Bid items. The Owner will select major equipment items within thirty (30) days after the date of the Notice to Proceed, provided Contractor has provided sufficient information to Owner/Engineer as noted above.
- F. The Bidder understands that equipment of a proposed alternate manufacturer must meet or exceed the requirements of the Contract Documents and Specifications, be of equal or better quality, and be of equal function to the base bid equipment.
- G. The price add/deduct for all items of equipment other than base bid items shall include the preparation and submission to the Owner of complete submittals, including detailed drawings showing all modifications, if any, necessary to accommodate such equipment.

- H. The price add/deduct for all items of equipment other than base bid items shall cover a complete operating installation, including any and all buildings, mechanical and electrical work, controls and accessories necessary to accommodate the selected equipment. Upon request, contractor shall provide work breakdown of additional items.
- I. The Bidder further understands that the Engineer will review said detailed Drawings or modifications and either approve them or indicate thereon changes necessary to comply with the project requirements in accordance with Article 6.05 of the General Conditions. Detailed drawings which are not approved will be revised and then resubmitted to the Engineer. The deduct and add amounts listed are "installed" prices and take into consideration and include any cost of the design or construction changes that may be required as a result of using the alternate equipment. Unless listed separately, the amount listed shall apply to the additive items also if they are awarded by the Owner.

SCHEDULE B - MANUFACTURERS & SUPPLIERS OF MAJOR EQUIPMENT & MATERIAL ITEMS

Item No.	Item Description	Amount
B1	Section 46 21 00 Screening Equipment	
	a. Lakeside	Included in Base Bid #A4
	b. _____ (Manufacturer)	Add/Deduct from Base Bid
TOTAL OF SCHEDULE B		

Note: The Bidder shall circle the word "Add" or "Deduct" to indicate that the amount for the Alternate Equipment or Material is to be added to or deducted from the Base Bid Lump Sum. This Schedule may be photocopied and attached to the Proposal if additional space for alternates is required.

3.03 Additive Alternatives

- A. Bidder will complete the Work in accordance with the Contract Documents for the following price(s), see Section 01 22 00 Measurement and Payment for additional information.
- B. Unit Price Labor or Lump Sum, as designated below.

SCHEDULE C – ADDITIVE ALTERNATIVES

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total Price
C1	Lagoon 3 clear and grub	80	HR	\$	\$
C2	Lagoon 3 Subgrade Compaction	40	HR	\$	\$
C3	Lagoon 3 Cushion Layer, 12 oz. Geotextile	1	LS	\$	\$
TOTAL OF SCHEDULE C					\$

ARTICLE 4—TIME OF COMPLETION

- 4.01 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.
- 4.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—BIDDER’S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

- 5.01 *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.
- 5.02 *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.
- 5.03 *Receipt of Addenda*
 - A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 6—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

- 6.01 *Bidder’s Representations*
 - A. In submitting this Bid, Bidder represents the following:
 - 1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
 - 2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - 3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - 4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
 - 5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

- A. The Bidder certifies the following:
 1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
 2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
 3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
 4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
 - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
 - b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
 - c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

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

BIDDER hereby submits this Bid as set forth above:

Bidder:

(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

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

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

Address for giving notices:

Bidder's Contact:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Phone: _____

Email: _____

Address: _____

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

BID BOND (PENAL SUM FORM)

Bidder Name: Address <i>(principal place of business)</i> :	Surety Name: Address <i>(principal place of business)</i> :
Owner Name: Mount Pleasant City Address <i>(principal place of business)</i> : Mount Pleasant City Hall 115 W Main St, Mount Pleasant, Utah, 84647	Bid Project <i>(name and location)</i> : Mount Pleasant Lagoon Improvements Project Bid Due Date: October 9, 2025
Bond Penal Sum: Date of Bond:	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder	Surety
<i>(Full formal name of Bidder)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i>	

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

NOTICE OF AWARD

Date of Issuance:

Owner: Mount Pleasant City

Owner's Project No.:

Engineer: J-U-B ENGINEERS, Inc.

Engineer's Project No.: 93-24-009

Project: Mt Pleasant Lagoon Improvements 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:

2025 Mt Pleasant Lagoon Improvements Project

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: **MOUNT PLEASANT CITY**

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 **Mount Pleasant City** (“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:

The Mt Pleasant Lagoon Improvements Project consists of lining lagoon 3 and the construction of a new headworks building, including installation of mechanical screens, odor control provisions, HVAC and plumbing, electrical, instrumentation, site work, yard piping, septage receiving station, and all other equipment and infrastructure needed to make the new facilities complete and operational. Project is located in Sanpete County, Utah.

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: **Mt Pleasant Lagoon Improvements Project**

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 **J-U-B ENGINEERS, Inc.** (“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.

4.03 *Contract Times: Days*

A. The Work will be substantially complete within **365** days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within **395** days after the date when the Contract Times commence to run.

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 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 **\$500** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
 2. *Completion of Remaining Work*: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **\$500** for each day that expires after such time until the Work is completed and ready for final payment.
 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.

4.06 *Special Damages*

- A. Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.
- B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.
- C. The special damages imposed in this paragraph are supplemental to any liquidated damages for delayed completion established in this Agreement.

ARTICLE 5—CONTRACT PRICE

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

- 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 5th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. **95** percent of the value of the Work completed (with the balance being retainage).
 - 1) If 50 percent or more of the Work has been completed, as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
 - b. **95** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
 - B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **100** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **200** percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

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

6.04 *Consent of Surety*

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

6.05 *Interest*

- A. All amounts not paid when due will bear interest at the rate of **10** percent per annum per UCA 15-1-1.

CONTRACT DOCUMENTS

7.01 *Contents*

- A. The Contract Documents consist of all of the following:
1. This Agreement.
 2. Bonds:
 - a. Performance bond (together with power of attorney).
 - b. Payment bond (together with power of attorney).
 3. General Conditions.
 4. Supplementary Conditions.
 5. Specifications as listed in the table of contents of the project manual (copy of list attached).
 6. Drawings (not attached but incorporated by reference) consisting of **[number]** sheets with each sheet bearing the following general title: **LAGOON IMPROVEMENTS PROJECT MT PLEASANT CITY.**
 8. Addenda (numbers ____ to ____, inclusive).
 9. Exhibits to this Agreement (enumerated as follows):
 - a. **None**
 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 7—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 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
4. “coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

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

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

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

Owner:

Mount Pleasant City

(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: Mount Pleasant City Owner's Project No.: _____
Engineer: J-U-B Engineers, Inc. Engineer's Project No.: 93-24-009
Contractor: _____ Contractor's Project No.: _____
Project: Mt Pleasant Lagoon Improvements 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 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: Mount Pleasant City
By *(signature)*: _____
Name *(printed)*: _____
Title: _____
Date Issued: _____
Copy: Engineer

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PERFORMANCE BOND

<p>Contractor</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>	<p>Surety</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>
<p>Owner</p> <p>Name: Mount Pleasant City</p> <p>Mailing address <i>(principal place of business)</i>: Mount Pleasant City Hall 115 W Main St, Mount Pleasant, Utah, 84647</p>	<p>Contract</p> <p>Description <i>(name and location)</i>: _____</p> <p>Contract Price: _____</p> <p>Effective Date of Contract: [Date from Contract]</p>
<p>Bond</p> <p>Bond Amount: _____</p> <p>Date of Bond: _____ <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16</p>	
<p>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.</p>	
Contractor as Principal	Surety
_____ <i>(Full formal name of Contractor)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

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:

- 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

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**

PAYMENT BOND

<p>Contractor</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>	<p>Surety</p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>
<p>Owner</p> <p>Name: Mount Pleasant City</p> <p>Mailing address <i>(principal place of business)</i>: Mount Pleasant City Hall 115 W Main St, Mount Pleasant, Utah, 84647</p>	<p>Contract</p> <p>Description <i>(name and location)</i>: _____</p> <p>Contract Price: _____</p> <p>Effective Date of Contract: [Date, from Contract]</p>
<p>Bond</p> <p>Bond Amount: _____</p> <p>Date of Bond: _____ <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18</p>	
<p>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.</p>	
Contractor as Principal	Surety
_____ <i>(Full formal name of Contractor)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

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

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

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

Contractor's Application for Payment

Owner: <u>Mount Pleasant City</u>	Owner's Project No.: _____
Engineer: <u>J-U-B Engineers, Inc.</u>	Engineer's Project No.: <u>93-24-009</u>
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: _____

Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner:	Mount Pleasant City	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	93-24-009
Contractor:		Contractor's Project No.:	
Project:			
Contract:			

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

A	B	C	D	E	F	G	H	I
Item No.	Description	Scheduled Value (\$)	Work Completed		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) (\$)
			(D + E) From Previous Application (\$)	This Period (\$)				
Original Contract								
			-			-		-
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
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						-		-
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						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
	Original Contract Totals	\$ -	\$ -	\$ -	\$ -	\$ -		\$ -

Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner: Mount Pleasant City
 Engineer: J-U-B Engineers, Inc.
 Contractor: _____
 Project: _____
 Contract: _____

Owner's Project No.: _____
 Engineer's Project No.: 93-24-009
 Contractor's Project No.: _____

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

A	B	C	D	E	F	G	H	I
Item No.	Description	Scheduled Value (\$)	Work Completed		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) (\$)
			(D + E) From Previous Application (\$)	This Period (\$)				
Change Orders								
						-		-
						-		-
						-		-
						-		-
						-		-
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						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
Change Order Totals		\$ -	\$ -	\$ -	\$ -	\$ -		\$ -
Original Contract and Change Orders								
Project Totals		\$ -	\$ -	\$ -	\$ -	\$ -		\$ -

Progress Estimate - Unit Price Work

Contractor's Application for Payment

Owner: Mount Pleasant City
 Engineer: J-U-B Engineers, Inc.
 Contractor: _____
 Project: _____
 Contract: _____

Owner's Project No.: _____
 Engineer's Project No.: 93-24-009
 Contractor's Project No.: _____

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

A	B	C	D	E	F	G	H	I	J	K	L
Bid Item No.	Description	Contract Information				Work Completed		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) (\$)
		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) (\$)				
Original Contract											
					-		-		-		-
					-		-		-		-
					-		-		-		-
					-		-		-		-
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					-		-		-		-
					-		-		-		-
					-		-		-		-
Original Contract Totals					\$ -		\$ -	\$ -	\$ -		\$ -

Progress Estimate - Unit Price Work

Contractor's Application for Payment

Owner: Mount Pleasant City
 Engineer: J-U-B Engineers, Inc.
 Contractor: _____
 Project: _____
 Contract: _____

Owner's Project No.: _____
 Engineer's Project No.: 93-24-009
 Contractor's Project No.: _____

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

A	B	C	D	E	F	G	H	I	J	K	L
Bid Item No.	Description	Contract Information				Work Completed		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) (\$)
		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) (\$)				
Change Orders											
					-		-		-		-
					-		-		-		-
					-		-		-		-
					-		-		-		-
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					-		-		-		-
					-		-		-		-
					-		-		-		-
Change Order Totals					\$ -		\$ -	\$ -	\$ -		\$ -
Original Contract and Change Orders											
Project Totals					\$ -		\$ -	\$ -	\$ -		\$ -

Stored Materials Summary

Contractor's Application for Payment

Owner: Mount Pleasant City
 Engineer: J-U-B Engineers, Inc.
 Contractor: _____
 Project: _____
 Contract: _____

Owner's Project No.: _____
 Engineer's Project No.: 93-24-009
 Contractor's Project No.: _____

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

A	B	C	D	E	F	Materials Stored			Incorporated in Work			M
						G	H	I	J	K	L	
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						\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: Mount Pleasant City
Engineer: J-U-B Engineers, Inc.
Contractor:
Project:
Contract Name:

Owner's Project No.:
Engineer's Project No.: 93-024-009
Contractor's Project No.:

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

- requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.
- b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. A demand for money or services by a third party is not a Claim.
11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the recipient; (d) the storage and archiving of the Electronic Document by sender and

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

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor’s plan to accomplish the Work within the Contract Times.
32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
1. does not conform to the Contract Documents;
 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

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

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

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

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments

during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

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

2.05 *Acceptance of Schedules*

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

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

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

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

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

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

B. *Resolving Discrepancies*

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

3.04 *Requirements of the Contract Documents*

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

- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

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

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

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

4.02 *Starting the Work*

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

4.03 *Reference Points*

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

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

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. Abnormal weather conditions;
 - 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

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

5.01 *Availability of Lands*

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

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.
 - C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

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

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

5.03 *Subsurface and Physical Conditions*

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

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

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

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

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

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

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

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

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

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

- a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
- a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

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

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

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

- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

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

- a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

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

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
3. Technical Data contained in such reports and drawings.

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

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

- of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

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

- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

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

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

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

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

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 Contractor's Insurance

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

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

6.04 *Builder's Risk and Other Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

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

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

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
 2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

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

7.02 *Supervision and Superintendence*

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

7.03 *Labor; Working Hours*

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

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
 - a. will certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design;
 - 2) be similar in substance to the item specified; and
 - 3) be suited to the same use as the item specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

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

7.09 *Permits*

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

7.10 *Taxes*

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

7.11 *Laws and Regulations*

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

7.12 *Record Documents*

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

7.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

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

7.15 *Emergencies*

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

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. *Samples*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

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

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

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

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
1. Observations by Engineer;
 2. Recommendation by Engineer or payment by Owner of any progress or final payment;
 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. Use or occupancy of the Work or any part thereof by Owner;
 5. Any review and approval of a Shop Drawing or Sample submittal;
 6. The issuance of a notice of acceptability by Engineer;
 7. The end of the correction period established in Paragraph 15.08;
 8. Any inspection, test, or approval by others; or
 9. Any correction of defective Work by Owner.

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

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

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

professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

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

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

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

Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

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

8.02 *Coordination*

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

8.03 *Legal Relationships*

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
 - 1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 - 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

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

9.03 *Furnish Data*

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

9.04 *Pay When Due*

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

- 9.05 *Lands and Easements; Reports, Tests, and Drawings*
- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
 - B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
 - C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.
- 9.06 *Insurance*
- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.
- 9.07 *Change Orders*
- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.
- 9.08 *Inspections, Tests, and Approvals*
- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.
- 9.09 *Limitations on Owner's Responsibilities*
- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- 9.10 *Undisclosed Hazardous Environmental Condition*
- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.
- 9.11 *Evidence of Financial Arrangements*
- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).
- 9.12 *Safety Programs*
- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
 - B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

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

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

10.05 *Determinations for Unit Price Work*

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

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

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

10.07 *Limitations on Engineer's Authority and Responsibilities*

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

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

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

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

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

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
 - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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

11.04 *Field Orders*

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

11.05 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
 2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
 3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will be determined as follows:
1. A mutually acceptable fixed fee; or
 2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;
 - c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

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

- B. *Change Proposal Procedures*

- 1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
- 2. *Supporting Data:* The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

- 3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
- 4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

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

ARTICLE 12—CLAIMS

12.01 *Claims*

- A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

- C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
 - 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

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

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 - 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
 5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

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

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
- 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
- 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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

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

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

D. *Contractor's Fee*

- 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
- 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

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

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

13.02 Allowances

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

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

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

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

14.01 *Access to Work*

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

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

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

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

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

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

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

14.05 *Uncovering Work*

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

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 Owner May Correct Defective Work

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

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

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. Payment Becomes Due

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

E. Reductions in Payment by Owner

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

- b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. The Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. The Contract Price has been reduced by Change Orders;
 - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or
 - l. Other items entitle Owner to a set-off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

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

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all duly pending Change Proposals and Claims; and

- e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim, appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

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

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their

reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

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

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this article, Owner or Contractor may:
1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if

repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Assignment of Contract*

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

18.09 *Successors and Assigns*

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

18.10 *Headings*

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

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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

No suggested Supplementary Conditions in this Article.

ARTICLE 2—PRELIMINARY MATTERS

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 **1** 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

3.01 *Intent*

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

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.

- b. The existence of abnormal weather conditions will be determined on a month-by-month basis upon mutual agreement between Owner and Contractor.

5.03 *Subsurface and Physical Conditions*

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

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Geotechnical Investigation Mt Pleasant Sewer Lagoons New Headworks Building	December 2024	Geotechnical 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
None		

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
None		

- 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
None		

ARTICLE 5—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

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

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

6.02 *Insurance—General Provisions*

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

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

6.03 *Contractor’s Insurance*

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

- 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: **None**
- 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	\$1,000,000
Bodily injury by disease—aggregate	\$1,000,000
Employer’s Liability	
Each accident	\$1,000,000
Each employee	\$1,000,000
Policy limit	\$1,000,000

Workers' Compensation and Related Policies	Policy limits of not less than:
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:	\$1,000,000

- F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:
1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
 2. damages insured by reasonably available personal injury liability coverage, and
 3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage.
 - a. Such insurance must be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
 4. Underground, explosion, and collapse coverage.
 5. Personal injury coverage.
 6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
 7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of “insured contract” (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured’s vicarious liability, strict liability, or statutory liability (other than worker’s compensation).
6. Any limitation or exclusion based on the nature of Contractor’s work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	\$2,000,000
Products—Completed Operations Aggregate	\$1,000,000
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:
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	\$2,000,000

- 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	\$2,000,000
General Aggregate	\$2,000,000

- 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 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 \$1,000,000 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	\$1,000,000
General Aggregate	\$2,000,000

- 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	\$1,000,000
Annual Aggregate	\$1,000,000

- 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 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	\$100,000
General Aggregate	\$200,000

- 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 premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of **\$15 percent of contract price**.
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 **\$5 percent of contract price**.
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.

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.
 1. The builder's risk policy (or if applicable the installation floater) will be subject to a deductible amount of no more than **\$100,000** 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 6—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 **7am-5pm**.
2. Owner's legal holidays are **New Year's Day, Martin Luther King, Jr. Day, Presidents Day, Memorial Day, Juneteenth, Independence Day, Pioneer Day, Labor Day, Thanksgiving Day and the following day, and Christmas Eve and Christmas Day**.

SC-7.03 Amend the first and second sentences of Paragraph 7.03.C to state “...all Work at the Site must be performed during regular working hours, **Monday** through **Friday**. Contractor will not perform Work on a **Saturday, Sunday**, or any legal holiday.”

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

- D. **Contractor** shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer’s services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

ARTICLE 7—OTHER WORK AT THE SITE

No suggested Supplementary Conditions in this Article.

ARTICLE 8—OWNER’S RESPONSIBILITIES

No suggested Supplementary Conditions in this Article.

ARTICLE 9—ENGINEER’S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

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

- C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:
1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor’s safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
 2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR’s own personal safety while at the Site.

3. *Liaison*
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.
 4. *Review of Work; Defective Work*
 - a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Observe whether any Work in place appears to be defective.
 - c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.
 5. *Inspections and Tests*
 - a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.
 - b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
 6. *Payment Requests: Review Applications for Payment with Contractor.*
 7. *Completion*
 - a. Participate in Engineer's visits regarding Substantial Completion.
 - b. Assist in the preparation of a punch list of items to be completed or corrected.
 - c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.
 - d. Observe whether items on the final punch list have been completed or corrected.
- D. The RPR will not:
1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
 4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.

- 5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 10—CHANGES TO THE CONTRACT

No suggested Supplementary Conditions in this Article.

ARTICLE 11—CLAIMS

No suggested Supplementary Conditions in this Article.

ARTICLE 12—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

13.01 *Cost of the Work*

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 **10** 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.

ARTICLE 13—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

No suggested Supplementary Conditions in this Article.

ARTICLE 14—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.01 *Progress Payments*

SC-15.01 Add the following new Paragraph 15.01.F:

- F. For contracts in which the Contract Price is based on the Cost of Work, if Owner determines that progress payments made to date substantially exceed the actual progress of the Work (as measured by reference to the Schedule of Values), or present a potential conflict with the Guaranteed Maximum Price, then Owner may require that Contractor prepare and submit a plan for the remaining anticipated Applications for Payment that will bring payments and progress into closer alignment and take into account the Guaranteed Maximum Price (if any), through reductions in billings, increases in retainage, or other equitable measures. Owner will review the plan, discuss any necessary modifications, and implement the plan as modified for all remaining Applications for Payment.

15.03 *Substantial Completion*

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

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

ARTICLE 15—SUSPENSION OF WORK AND TERMINATION

No suggested Supplementary Conditions in this Article.

ARTICLE 16—FINAL RESOLUTIONS OF DISPUTES

No suggested Supplementary Conditions in this Article.

ARTICLE 17—MISCELLANEOUS

No suggested Supplementary Conditions in this Article.

EXHIBIT A—SOFTWARE REQUIREMENTS FOR ELECTRONIC DOCUMENT EXCHANGE

Item	Electronic Documents	Transmittal Means	Data Format	Note (1)
a.1	General communications, transmittal covers, meeting notices and responses to general information requests for which there is no specific prescribed form.	Email	Email	
a.2	Meeting agendas, meeting minutes, RFI's and responses to RFI's, and Contract forms.	Email w/ Attachment	PDF	(2)
a.3	Contactors Submittals (Shop Drawings, "or equal" requests, substitution requests, documentation accompanying Sample submittals and other submittals) to Owner and Engineer, and Owner's and Engineer's responses to Contractor's Submittals, Shop Drawings, correspondence, and Applications for Payment.	Email w/ Attachment	PDF	
a.4	Correspondence; milestone and final version Submittals of reports, layouts, Drawings, maps, calculations and spreadsheets, Specifications, Drawings and other Submittals from Contractor to Owner or Engineer and for responses from Engineer and Owner to Contractor regarding Submittals.	Email w/ Attachment or LFE	PDF	
a.5	Layouts and drawings to be submitted to Owner for future use and modification.	Email w/ Attachment or LFE	DWG	
a.6	Correspondence, reports and Specifications to be submitted to Owner for future word processing use and modification.	Email w/ Attachment or LFE	DOC	
a.7	Spreadsheets and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	EXC	
a.8	Database files and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	DB	
Notes				
(1)	All exchanges and uses of transmitted data are subject to the appropriate provisions of Contract Documents.			
(2)	Transmittal of written notices is governed by Paragraph 18.01 of the General Conditions.			
Key				
Email	Standard Email formats (.htm, .rtf, or .txt). Do not use stationery formatting or other features that impair legibility of content on screen or in printed copies			
LFE	Agreed upon Large File Exchange method (FTP, CD, DVD, hard drive)			
PDF	Portable Document Format readable by Adobe® Acrobat Reader Version 24 or later			
DWG	Autodesk® AutoCAD .dwg format Version 2023			
DOC	Microsoft® Word .docx format Version 2024			
EXC	Microsoft® Excel .xls or .xml format Version 2024			
DB	Microsoft® Access .mdb format Version 2024			

WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]

Owner: Mount Pleasant City
Engineer: J-U-B Engineers, Inc
Contractor:
Project: Mount Pleasant Lagoon Improvements Project
Contract Name:
Date Issued: Effective Date of Work Change Directive:
Owner's Project No.:
Engineer's Project No.: 93-24-009
Contractor's Project No.:

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:	Mount Pleasant City	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc	Engineer's Project No.:	93-24-009
Contractor:		Contractor's Project No.:	
Project:	Mount Pleasant Lagoon Improvements 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: _____

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FIELD ORDER NO.: [Number of Field Order]

Owner: Mount Pleasant City
Engineer: J-U-B Engineers, Inc
Contractor:
Project: Mount Pleasant Lagoon Improvements Project
Contract Name:
Date Issued: Effective Date of Field Order:
Owner's Project No.:
Engineer's Project No.: 93-24-009
Contractor's Project No.:

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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SRF SPECIAL CONDITIONS

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION LOWER TIER COVERED TRANSACTIONS

Instructions for Certification

1. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.
2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.
3. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or had become erroneous by reason of changed circumstances.
4. The terms covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used in this clause, have the meaning set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.
5. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is proposed for debarment under 48 CFR part 9, subpart 9.4, debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
6. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not proposed for debarment

under 48 CFR part 9, subpart 9.4, debarred, suspended, ineligible, or voluntarily excluded from covered transactions, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is proposed for debarment under 48 CFR part 9, subpart 9.4, suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Covered Transactions

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name

Name and Title of Authorized Representative

Signature

Date

EQUAL OPPORTUNITY CLAUSES

- A. The Equal Opportunity Clause published at 41 CFR 60-1.4(b) is required to be included in, and is part of, all nonexempt federally assisted construction contracts and subcontracts (including this Contract). The Equal Opportunity Clause shall be considered to be a part of every contract and subcontract required by the regulations to include such a clause, whether or not it is physically incorporated in such contracts. The notices required to be posted by paragraphs (1) and (3) of the Equal Opportunity Clause shall be the "Equal Employment Opportunity is the Law" poster approved by the Office of Federal Contract Compliance Programs and available on the internet at: <https://www.dol.gov/agencies/oasam/centers-offices/civil-rights-center/external/compliance-assistance>.

EQUAL OPPORTUNITY CLAUSE (41 CFR 60-1.4(b))

During the performance of this contract, the contractor agrees as follows:

- (1) The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
- (2) The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.
- (3) The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
- (4) The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.
- (5) The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
- (6) In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures

authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(7) The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States.

B. The Standard Federal Equal Employment Opportunity Construction Contract Specifications published at 41 CFR 60-4.3(a) are required to be included in, and are part of, all federal and federally assisted construction contracts and subcontracts (including this Contract) in excess of \$10,000 to be performed in geographical areas designated by the Director pursuant to 41 CFR 60-4.6 and in construction subcontracts in excess of \$10,000 necessary in whole or in part to the performance of non-construction Federal contracts and subcontracts covered under Executive Order 11246. These Specifications shall be considered to be a part of every contract and subcontract required by the regulations to include such a clause, whether or not it is physically incorporated in such contracts.

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION
CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246)

1. As used in these specifications:
 - a. "Covered Area" means the geographical area described in the solicitation from which this contract resulted;
 - b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
 - c. "Employer identification number" means the Federal Social Security number used on the employer's quarterly Federal Tax Return, U.S. Treasury Department Form 941.
 - d. "Minority" includes:
 - (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
 - (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);
 - (iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
3. If the contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area, (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.
4. The contractor shall implement the specific affirmative action standards provided in paragraphs (7)(a) through (p) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of

minority and female utilization the contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the FEDERAL REGISTER in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.
6. In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
7. The contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
 - a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the contractor's employees are assigned to work. The contractor, where possible, will assign two or more women to each construction project. The contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
 - b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
 - c. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the contractor by the union or, if referred, not employed by the contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the contractor may have taken.
 - d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a

minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

- e. Develop on-the-job training opportunities and/or participate in training programs for the areas which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the contractor's employment needs, especially those programs funded or approved by the Department of Labor. The contractor shall provide notice of these programs to the sources compiled under (7)(b) above.
- f. Disseminate the contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the contractor's EEO policy with other contractors and subcontractors with whom the contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
- l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

- m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the contractor's obligations under these specifications are being carried out.
 - n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
 - o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
 - p. Conduct a review, at least annually, of all supervisor's adherence to and performance under the contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7)(a) through (p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under (7)(a) through (p) of these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's and failure of such a group to fulfill an obligation shall not be a defense for the contractor's noncompliance.
9. A single goal for minorities and a separate single goal for women have been established. The contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the contractor has achieved its goals for women generally, the contractor may be in violation of the Executive order if a specific minority group of women is under-utilized).
10. The contractor shall not use the goals and timetables of affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
11. The contractor shall not enter into any subcontract with any person or firm debarred from government contracts pursuant to Executive Order 11246.
12. The contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph (7) of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.
14. The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.
15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

Attachment 1
SRF Required Front-End Specifications
(This form must be completed and signed by Prime Contractor and Submitted with the bid.)

U.S. Environmental Protection Agency
Certification of Non-Segregated Facilities

(Applicable to contracts, subcontracts, and agreements with applicants who are themselves performing Federally assisted construction contracts, exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause.)

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause; that we will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

**NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR
CERTIFICATION OF NON-SEGREGATED FACILITIES**

A Certification of Non-segregated Facilities, as required by the May 9, 1967, order (33 F.R. 7808, May 28, 1968) on Elimination of Segregated Facilities, by the Secretary of Labor must be submitted prior to the award of the subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

Signature

Date

Name and Title of Signer (Please Type)

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

February 2009

EPA-7 5720-4.2

PROHIBITION AGAINST LISTED VIOLATING FACILITIES

A. REQUIREMENTS

- (1) To comply with all the requirements of section 114 of the Clean Air Act, as amended (42 U.S.C. 1857, et seq., as amended by Pub. L. 92-604) and section 308 of the Clean Water Act (33 U.S.C. 1251, as amended), respectively, which relate to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, respectively, and all regulations and guidelines issued thereunder before the award of this contract.
- (2) That no portion of the work required by this prime contract will be performed in a facility listed on the Environmental Protection Agency list of violating facilities on the date when this contract was awarded unless and until the EPA eliminates the name of such facility or facilities from the listing.
- (3) To use his best efforts to comply with clean air and clean water standards at the facilities in which the contract is being performed.
- (4) To insert the substance of the provisions of this clause, including this paragraph (4), in any nonexempt subcontract.

B. DEFINITIONS

- (1) Air Act means the Clean Air Act, as amended (42 U.S.C. 1857 et seq.).
- (2) Water Act means the Clean Water Act, as amended (33 U.S.C. 1251 et seq.).
- (3) Clean Air Standards means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted under the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 (d) of the Air Act (42 U.S.C. 1857c-5(d)), an approved implementation procedure or plan under section 111 (c) or section 111(d), or an approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 1857c-7(d)).
- (4) Clean Water Standards means any enforceable limitation, control, condition, prohibition, standard, or other requirement which is promulgated under the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by a local government to ensure compliance with pretreatment regulations as required by section 307 of Water Act (33 U.S.C. 1317).
- (5) Compliance means compliance with clean air or water standards. Compliance shall also mean compliance with a schedule or plan ordered or approved by a court of competent jurisdiction, the Environmental Protection Agency in accordance with the requirements of the Air Act or Water Act and regulations.
- (6) Facility means any building, plant, installation, structure, mine, vessel, or other floating craft, location, or site of operations, owned, leased, or supervised by a contractor or subcontractor, to be used in the performance of a contract or subcontract. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location or site shall be

deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are located in one geographical area.

WILLIAMS-STEIGER OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

A. AUTHORITY

- (1) The contractor is subject to the provisions of the Williams-Steiger Occupational Safety and Health Act of 1970.
- (2) These construction documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of the Federal law(s), including but not limited to the latest amendment of the following:
 - a. Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 94-596;
 - b. Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations;
 - c. Part 1926 - Safety and Health Regulations for Construction, Chapter XVII of Title 29, Code of Federal Regulations.

B. SAFETY AND HEALTH PROGRAM REQUIREMENTS

- (1) This project, its prime contractor and its subcontractors, shall at all times be governed by Chapter XVII of Title 29, Code of Federal Regulations, Part 1926 - Safety and Health Regulations for Construction (29 CFR 22801), as amended to date.
- (2) To implement the program and to provide safe and healthful working conditions for all persons, general project safety meetings will be conducted at the site at least once each month during the course of construction, by the construction superintendent or his/her designated safety officer. Notice of such meeting shall be issued not less than three (3) days prior, stating the exact time, location, and agenda to be included. Attendance by the owner, architect, general foreman, shop steward(s), and trades, or their designated representatives, witnessed in writing as such, shall be mandatory.
- (3) To further implement the program, each trade shall conduct a short gang meeting, not less than once a week, to review project safety requirements mandatory for all persons during the coming week. The gang foreman shall report the agenda and specific items covered to the project superintendent, who shall incorporate these items in his/her daily log or report.
- (4) The prime contractor and all subcontractors shall immediately report all accidents, injuries, or health hazards to the owner and architect, or their designated representatives, in writing. This shall not obviate any mandatory reporting under the provisions of the Occupational Safety and Health Act of 1970.
- (5) This program shall become a part of the contract documents and the contract between the owner and prime contractor, prime contractor and all subcontractors, as though fully written therein.

ANTI-KICKBACKS

Contractor shall comply with the Copeland "Anti-Kickback" Act (18 U.S.C. 874) as supplemented in the Department of Labor Regulations (29 CFR, Part 3). This Act provides that Contractor is prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he is otherwise entitled.

Contractor certifies and warrants that no gratuities, kickbacks and contingency fees were paid in connection with this contract, nor were any fees, commissions, gifts, or other considerations made contingent upon the award of this contract.

Contractor certifies that, to Contractor's knowledge, no state employee has any personal or beneficial interest whatsoever in the services described in this Contract.

No staff member of Contractor, compensated either partially or wholly with funds disbursed pursuant to the Contract, shall engage in any Contract or activity which would constitute a conflict of interest as related to this Contract.

DISCOVERY OF ARCHAEOLOGICAL AND OTHER HISTORICAL ITEMS

In the event of an archaeological find during any phase of construction, the following procedure will be followed:

1. Construction shall be halted, with as little disruption to the archaeological site as possible.
2. Contractor shall notify Owner who shall contact the State Historic Preservation Officer.
3. The State Historic Preservation Officer may decide to have an archaeologist inspect the site and make recommendations about the steps needed to protect the site, before construction is resumed.
4. The entire event should be handled as expediently as possible in order to hold the loss in construction time to a minimum while still protecting archaeological finds.

A similar procedure should be followed with regard to more recent historical resources. Should any artifacts, housing sites, etc., be uncovered, the same procedure should be followed as for an archaeological find.

In the event archaeological/historical data are evaluated to meet National Register criteria, the Advisory Council on Historic Preservation may be notified and asked to comment by the Utah State Revolving Fund Program.

ACCESS

Contractor and loan recipient shall insure that authorized representatives of the Utah DEQ, State Historic Preservation Office, US EPA, Comptroller General, Inspector General, and other applicable federal and state agencies and officials will have access to the project work whenever it is in preparation or progress and shall provide proper facilities for such access and inspection. Contractor shall allow these representatives to have access to any books, documents, plans, reports, papers, and other records of Contractor which are pertinent to the project for the purpose of making audit, examination, excerpts, copies and transcriptions thereof and to interview any officer or employee. Contractor shall ensure that all subagreements will also afford access to such project work, sites, documents, records, and persons.

SITE EROSION AND SEDIMENT CONTROL MEASURES

Every effort shall be made by Contractor and subcontractors to prevent and correct problems associated with erosion and runoff processes which could occur during and after project construction. The efforts should be consistent with applicable local ordinances and the Nonpoint Source Pollution Control Guidance. Whenever appropriate, Contractor's efforts shall reflect the following engineering principles:

- (a) When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems which require extensive control measures.
- (b) Whenever possible, topsoil should be removed and stockpiled before grading begins.
- (c) Land exposure should be minimized in terms of area and time.
- (d) Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation.
- (e) Natural vegetation should be retained whenever feasible.
- (f) Early completion of stabilized drainage systems (temporary and permanent systems) will substantially reduce erosion potential.
- (g) Roadways and parking lots should be paved or otherwise stabilized as soon as feasible.
- (h) Clearing and grading should not be started until a firm construction schedule is known and can be effectively coordinated with grading and clearing activity.

UPDES CONSTRUCTION RELATED DISCHARGE PERMITS

Construction projects which will disturb one or more acres will require coverage under the State of Utah General Permit for Storm Water Discharges Associated with Large Construction Activities. Contractor is responsible for obtaining coverage under the appropriate permit and maintaining compliance until Owner accepts the Work as complete. For additional information see <https://deq.utah.gov/water-quality/general-construction-storm-water-updes-permits>.

Certain construction activities such as dewatering, flushing, testing, and disinfection require coverage under the State of Utah General Permit for Temporary Discharges or under a separate discharge permit. Contractor is responsible for obtaining any necessary coverage and maintaining compliance. For more information see <https://deq.utah.gov/water-quality/general-construction-storm-water-updes-permits>.

AIR QUALITY PROTECTION MEASURES

Contractor shall adhere to effective dust control procedures as required under the Utah Air Quality Standards and Regulations UAC R307. If asbestos is encountered during this project, Contractor shall follow standards for handling according to UAC R307-801. Contractor shall adhere to proper trade waste and materials disposal.

PRESERVATION OF OPEN COMPETITION AND GOVERNMENT NEUTRALITY TOWARDS GOVERNMENT CONTRACTORS' LABOR RELATIONS ON FEDERAL AND FEDERALLY FUNDED CONSTRUCTION PROJECTS

The assistance recipient agrees to comply with Executive Order 13202 (Feb. 22, 2001, 66 Federal Register 11225) of February 17, 2001, entitled "Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects," as amended by Executive Order 13208 (April 11, 2001, 66 Federal Register 18717) of April 6, 2001, entitled "Amendment to Executive Order 13202, Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects.

Amend 48 CFR Part 36.202 by adding paragraph (d) to read as follows:

- (d) In accordance with Executive Order 13202, of February 17, 2001, Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects, as amended on April 6, 2001—
- (1) The Government, or any construction manager acting on behalf of the Government, must not—
 - (i) Require or prohibit offerors, contractors, or subcontractors to enter into or adhere to agreements with one or more labor organizations (as defined in 42 U.S.C. 2000e(d)) on the same or other related construction projects; or
 - (ii) Otherwise discriminate against offerors, contractors, or subcontractors for becoming, refusing to become, or remaining signatories or otherwise adhering to agreements with one or more labor organizations, on the same or other related construction projects.
 - (2) Nothing in this paragraph prohibits offerors, contractors, or subcontractors from voluntarily entering into project labor agreements.
 - (3) The head of the agency may exempt a construction project from this policy if the agency head finds that, as of February 17, 2001—
 - (i) The agency or a construction manager acting on behalf of the Government had issued or was a party to bid specifications, project agreements, agreements with one or more labor organizations, or other controlling documents with respect to that particular project, which contained any of the requirements or prohibitions in paragraph (d)(1) of this section; and
 - (ii) One or more construction contracts subject to such requirements or prohibitions had been awarded.
 - (4) The head of the agency may exempt a particular project, contract, or subcontract from this policy upon a finding that special circumstances require an exemption in order to avert an imminent threat to public health or safety, or to serve the national security. A finding of "special circumstances" may not be based on the possibility or presence of a labor dispute concerning the use of contractors or subcontractors who are nonsignatories to, or otherwise do not adhere to, agreements with one or more labor organizations, or concerning employees on the project who are not members of or affiliated with a labor organization.

AMERICAN IRON AND STEEL ACT REQUIREMENT

None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) shall be used for a project for the construction, alteration, maintenance, or repair of a public treatment works unless all of the iron and steel products used in the project are produced in the United States.

The Contractor acknowledges to and for the benefit of _____ (“Purchaser”) and the Utah Division of Water Quality (the “State”) that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund (CWSRF) and/or Drinking Water State Revolving Fund (DWSRF) that have statutory requirements commonly known as “American Iron and Steel;” that requires all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”) including iron and steel products provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that:

- (a) the Contractor has reviewed and understands the American Iron and Steel Requirement,
- (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and
- (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State.

Notwithstanding any other provision of this Agreement, any failure to comply with this requirement by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney’s fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

The full American Iron and Steel Guidance can be found at:
http://water.epa.gov/grants_funding/aisrequirement.cfm

AMERICAN IRON AND STEEL REQUIREMENT GUIDANCE

Covered American Iron and Steel (AIS) Products

1. What is an iron or steel product?

For purposes of the CWSRF projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the project:

- Lined or unlined pipes or fittings;
- Manhole Covers;
- Municipal Castings (defined in more detail later in this guidance);
- Hydrants;
- Tanks;
- Flanges;
- Pipe clamps and restraints;
- Valves;
- Structural steel (defined in more detail later in this guidance);
- Reinforced precast concrete; and
- Construction materials (defined in more detail later in this guidance).

2. What does the term ‘primarily iron or steel’ mean?

‘Primarily iron or steel’ places constraints on the list of products above. For one of the listed products to be considered subject to the AIS requirements, it must be made of greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.

For example, the iron portion of a fire hydrant would likely be the bonnet, body and shoe, and then the cost would include the pouring and casting to create those components. The other material costs would include non-iron and steel internal workings of the fire hydrant (i.e. stem, coupling, valve, seals, etc.). However, the assembly of the internal workings into the hydrant body would not be included in this cost calculation. If one of the listed products is not made primarily of iron or steel, United States provenance is not required. An exception to this definition is reinforced precast concrete, which is addressed later in this guidance.

3. If a product is composed of more than 50% iron or steel, but is not listed in the above list of items, must the item be produced in the US? Alternatively, must the iron or steel in such a product be produced in the US?

The answer to both questions is no. Only items on the above list must be produced in the US. Additionally, the iron or steel in a non-listed item can be sourced from outside the US.

4. What is the definition of steel?

Steel means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

5. What does ‘produced in the United States’ mean?

Production in the United States of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes including processes such as melting, refining, forming, rolling, drawing,

finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

6. Are the raw materials used in the production of iron or steel required to come from US sources?

No, raw materials, such as iron ore, limestone, scrap iron, and scrap steel, can come from non-US sources.

7. If an above listed item is primarily made of iron or steel, but is only at the construction site temporarily, must such an item be produced in the US?

No. Only the above listed products made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example trench boxes or scaffolding, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

8. What is the definition of ‘municipal castings’?

Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are:

- Access Hatches;
- Ballast Screen;
- Benches (Iron or Steel);
- Bollards;
- Cast Bases;
- Cast Iron Hinged Hatches, Square and Rectangular;
- Cast Iron Riser Rings;
- Catch Basin Inlet;
- Cleanout/Monument Boxes;
- Construction Covers and Frames;
- Curb and Corner Guards;
- Curb Openings;
- Detectable Warning Plates;
- Downspout Shoes (Boot, Inlet);
- Drainage Grates, Frames and Curb Inlets;
- Inlets;
- Junction Boxes;
- Lampposts;

- Manhole Covers, Rings and Frames, Risers;
- Meter Boxes;
- Steel Hinged Hatches, Square and Rectangular;
- Steel Riser Rings;
- Trash receptacles;
- Tree Grates;
- Tree Guards;
- Trench Grates; and
- Valve Boxes, Covers and Risers.

9. What is ‘structural steel’?

Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

10. What is a ‘construction material’ for purposes of the AIS requirement?

Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered “structural steel”. This includes, but is not limited to, the following products:

- wire rod,
- bar,
- angles,
- concrete reinforcing bar,
- wire,
- wire cloth,
- wire rope and cables,
- tubing,
- framing,
- joists,
- trusses,
- fasteners (i.e. nuts and bolts),
- welding rods,
- decking,
- grating,
- railings,

- stairs,
- access ramps,
- fire escapes,
- ladders,
- wall panels,
- dome structures,
- roofing,
- ductwork,
- surface drains,
- cable hanging systems,
- manhole steps,
- fencing and fence tubing,
- guardrails,
- doors,
- stationary screens

11. What is not considered a ‘construction material’ for purposes of the AIS requirement?

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials:

- pumps,
- motors,
- gear reducers,
- drives (including variable frequency drives (VFDs))
- electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators)
- mixers,
- gates,
- motorized screens (such as traveling screens),
- blowers/aeration equipment,
- compressors,
- meters,
- sensors,
- controls and switches,

- supervisory control and data acquisition (SCADA)
- membrane bioreactor systems,
- membrane filtrations systems,
- filters,
- clarifiers and clarifier mechanisms,
- rakes,
- grinders,
- disinfection systems,
- presses (including belt presses),
- conveyors,
- cranes,
- HVAC (excluding ductwork),
- water heaters,
- heat exchangers,
- generators,
- cabinetry and housings (such as electrical boxes/enclosures),
- lighting fixtures,
- electrical conduit,
- emergency life systems,
- metal office furniture,
- shelving,
- laboratory equipment,
- analytical instrumentation,
- dewatering equipment

12. If the iron or steel is produced in the US, may other steps in the manufacturing process take place outside of the US, such as assembly?

No. Production in the US of the iron or steel used in a listed product requires that all manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

13. What processes must occur in the US to be compliant with the AIS requirement for reinforced precast concrete?

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the

reinforcing rebar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin.

If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

Compliance with AIS Requirements

1. How should an assistance recipient document compliance with the AIS requirement?

In order to ensure compliance with the AIS requirement, specific AIS contract language must be included in each contract, starting with the assistance agreement (bond, grant agreement), all the way down to the subcontractor and purchase agreements. Language for contracts should be similar to the American Iron and Steel Requirement provision in this contract.

EPA recommends the use of a step certification process, similar to one used by the Federal Highway Administration. The step certification process is a method to ensure adherence to AIS requirements and assistance recipients can verify that products comply with the AIS requirement. The process also establishes accountability and better enables States to take enforcement actions against violators.

Step certification creates a paper trail which documents the location of the manufacturing process involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer, processor, etc.) of the iron and steel products certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin. A certification can be quite simple. Typically, it includes the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. A sample certification is located in this section. These certifications should be collected and maintained by the assistance recipients.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes occurred in the US. While this type of certification may be acceptable, it does not provide the same degree of assurance. Additional documentation may be needed if the certification is lacking important information. Step certification is the best practice.

2. How will the State will ensure assistance recipients are complying with the AIS requirement?

In order to ensure compliance with the AIS requirement, the State must include specific AIS contract language in the assistance agreement (i.e. bond, grant agreement, etc.). The assistance recipient must include specific AIS contract language in the project's contract documents.

The State will also conduct site visits of projects during construction and review documentation demonstrating proof of compliance which the assistance recipient has gathered.

3. What happens if a State or EPA finds a non-compliant iron and/or steel product permanently incorporated in the project?

If a potentially noncompliant product is identified, the State will notify the assistance recipient of the apparent unauthorized use of the non-domestic component, including a proposed corrective action, and should be given the opportunity to reply. If unauthorized use is confirmed, the State can take

one or more of the following actions:

- request a waiver where appropriate;
- require the removal of the non-domestic item; or
- withhold payment for all or part of the project.

Only EPA can issue waivers to authorize the use of a non-domestic item. EPA may use remedies available to it under the Clean Water Act and 40 CFR part 31 grant regulations in the event of a violation of a grant term and condition.

It is recommended that the State work collaboratively with EPA to determine the appropriate corrective action, especially in cases where the State is the one who identifies the item in noncompliance or there is a disagreement with the assistance recipient.

If fraudulent activities are suspected, the Office of Inspector General (OIG) should be contacted immediately. The OIG can be reached at 1-888-546-8740 or OIG_Hotline@epa.gov. More information can be found at this website: <http://www.epa.gov/oig/hotline.htm>.

4. How do international trade agreements affect the implementation of the AIS requirements?

The AIS provision applies in a manner consistent with United States obligations under international agreements. Typically, these obligations only apply to direct procurement by the entities that are signatories to such agreements. In general, SRF assistance recipients are not signatories to such agreements, so these agreements have no impact on this AIS provision. In the few instances where such an agreement applies to a municipality, that municipality is under the obligation to determine its applicability and requirements and document the actions taken to comply for the State.

AIS Requirement Waiver Process

The statute permits EPA to issue waivers for a case or category of cases where EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent.

In order to implement the AIS requirements, EPA has developed an approach to allow for effective and efficient implementation of the waiver process to allow projects to proceed in a timely manner. The framework described later in this guidance will allow States to apply for waiver, on the behalf of the assistance recipients, to apply for waivers of the AIS requirement directly to EPA Headquarters. Pursuant to the Act, EPA has the responsibility to make findings as to the issuance of waivers to the AIS requirements.

- Reasonably Available Quantity means the quantity of iron or steel products is available or will be available at the time needed and place needed, and in the proper form or specification as specified in the project plans and design.
- Satisfactory Quality means the quality of iron or steel products, as specified in the project plans and designs.
- Assistance Recipient means a borrower or grantee that receives funding from a State CWSRF program.

Information Checklist for Waiver Request

The purpose of this checklist is to help ensure that all appropriate and necessary information is submitted to EPA. EPA recommends that waiver applicants review this checklist carefully and provide all appropriate information to EPA. This checklist is for informational purposes only and does not need to be included as part of a waiver application.

Items	✓	Notes
<p>General</p> <ul style="list-style-type: none"> ● Waiver request includes the following information: <ul style="list-style-type: none"> — Description of the foreign and domestic construction materials — Unit of measure — Quantity — Price — Time of delivery or availability — Location of the construction project — Name and address of the proposed supplier — A detailed justification for the use of foreign construction materials ● Waiver request was submitted according to the instructions in the memorandum ● Assistance recipient made a good faith effort to solicit bids for domestic iron and steel products, as demonstrated by language in requests for proposals, contracts, and communications with the prime contractor 		
<p>Cost Waiver Requests</p> <ul style="list-style-type: none"> ● Waiver request includes the following information: <ul style="list-style-type: none"> — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products — Relevant excerpts from the bid documents used by the contractors to complete the comparison — Supporting documentation indicating that the contractor made a reasonable survey of the market, such as a description of the process for identifying suppliers and a list of contacted suppliers 		
<p>Availability Waiver Requests</p> <ul style="list-style-type: none"> ● Waiver request includes the following supporting documentation necessary to demonstrate the availability, quantity, and/or quality of the materials for which the waiver is requested: <ul style="list-style-type: none"> — Supplier information or pricing information from a reasonable number of domestic suppliers indicating availability/delivery date for construction materials — Documentation of the assistance recipient’s efforts to find available domestic sources, such as a description of the process for identifying suppliers and a list of contacted suppliers. — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of construction materials ● Waiver request includes a statement from the prime contractor confirming the non-availability of the domestic construction materials for which the waiver is sought ● Has the State received other waiver requests for the materials described in this waiver request, for comparable projects? 		

HQ Review Checklist for Waiver Request

Instructions: To be completed by EPA. Review all waiver requests using the questions in the checklist, and mark the appropriate box as Yes, No or N/A. Marks that fall inside the shaded boxes may be grounds for denying the waiver. If none of your review markings fall into a shaded box, the waiver is eligible for approval if it indicates that one or more of the following conditions applies to the domestic product for which the waiver is sought:

1. The iron and/or steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.
2. The inclusion of iron and/or steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Review Items	Yes	No	N/A	Comments
Cost Waiver Requests <ul style="list-style-type: none"> • Does the waiver request include the following information? <ul style="list-style-type: none"> – Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products – Relevant excerpts from the bid documents used by the contractors to complete the comparison – A sufficient number of bid documents or pricing information from domestic sources to constitute a reasonable survey of the market • Does the Total Domestic Project exceed the Total Foreign Project Cost by more than 25%? 				
Availability Waiver Requests <ul style="list-style-type: none"> • Does the waiver request include supporting documentation sufficient to show the availability, quantity, and/or quality of the iron and/or steel product for which the waiver is requested? <ul style="list-style-type: none"> – Supplier information or other documentation indicating availability/delivery date for materials – Project schedule – Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of materials • Does supporting documentation provide sufficient evidence that the contractors made a reasonable effort to locate domestic suppliers of materials, such as a description of the process for identifying suppliers and a list of contacted suppliers? • Based on the materials delivery/availability date indicated in the supporting documentation, will the materials be unavailable when they are needed according to the project schedule? (By item, list schedule date and domestic delivery quote date or other relevant information) • Is EPA aware of any other evidence indicating the non-availability of the materials for which the waiver is requested? Examples include: <ul style="list-style-type: none"> – Multiple waiver requests for the materials described in this waiver request, for comparable projects in the same State – Multiple waiver requests for the materials described in this waiver request, for comparable projects in other States – Correspondence with construction trade associations indicating the non-availability of the materials • Are the available domestic materials indicated in the bid documents of inadequate quality compared those required by the project plans, specifications, and/or permits? 				

Sample Step Certification Letter

The following information is provided as a sample letter of **step** certification for AIS compliance. Documentation must be provided on company letterhead.

Date
Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA’s State Revolving Fund Programs.

Item, Products and/or Materials:

- 1. Xxxx
- 2. Xxxx
- 3. Xxxx

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Sample Certification Letter

The following information is provided as a sample letter of certification for AIS compliance. Documentation must be provided on company letterhead.

Date
Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Certification for Project (XXXXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA’s State Revolving Fund Programs.

Item, Products and/or Materials:

- 1. XXXX
- 2. XXXX
- 3. XXXX

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Prohibition on Certain Telecommunication and Video Surveillance Services or Equipment in the SRF Programs

Taken from December 11, 2020 EPA Memorandum:

Effective August 13, 2020, recipients and subrecipients of EPA funded assistance agreements, including borrowers under EPA funded revolving loan funds, must comply with regulations at 2 CFR 200.216, Prohibition on certain telecommunication and video surveillance services or equipment, implementing section 889 of Public Law 115-232. The regulation prohibits the use of Federal funds to procure (enter into, extend, or renew contracts) or obtain equipment, systems, or services that use “covered telecommunications equipment or services” identified in the regulation as a substantial or essential component of any system, or as critical technology as part of any system. Prohibitions extend to the use of Federal funds by recipients and subrecipients to enter into a contract with an entity that “uses any equipment, system, or service 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. Certain equipment, systems, or services, including equipment, systems, or services produced or provided by entities subject to the prohibition are recorded in the System for Award Management exclusion list.

As described in section 889 of Public Law 115-232, covered telecommunications equipment or services includes:

- Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).
- For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, 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).
- Telecommunications or video surveillance services provided by such entities or using such equipment.
- 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.

Applicability in the State Revolving Fund (SRF) Programs

Clean Water and Drinking Water SRF (CWSRF and DWSRF) programs may not expend equivalency funds for these products on or after August 13, 2020. States must ensure that equivalency assistance agreements include the telecommunications prohibition condition provided by EPA’s Office of Grants and Debarment (OGD) in OGD’s most recent EPA General Terms and Conditions. The condition must also be in construction contracts associated with equivalency assistance agreements. There is no exhaustive list of components and services that fall under the prohibition. State SRF managers and local assistance recipients should exercise due diligence and be particularly mindful of project components with internet or cellular connections. For example, recipients should be mindful of automatic meter reading (AMR) technology and advanced metering infrastructure (AMI), instrumentation control systems (e.g. process control systems,

distributed control systems and programmable logic controls), and security cameras and other electronic security measures to ensure that those items are procured from a non-excluded entity. Items included in the prohibition are not eligible SRF costs, and the SRF programs cannot reimburse borrowers for these costs.

The prohibition also applies to the CWSRF administrative funds (if states are billing those costs to the federal CWSRF capitalization grant) and the four DWSRF set-asides. States should be mindful of items such as cell phones, computers, and mobile WiFi routers or hotspots funded by those accounts. If you have questions on the implementation of this grant condition, please contact Michael Deane at Deane.Michael@epa.gov or Kiri Anderer at Anderer.Kirsten@epa.gov.

REQUIRED POSTERS

Many of the required workplace posters can be found at <https://www.dol.gov/general/topics/posters/>. The following posters required for the project, include but are not limited to:

1.	Minimum Wage Poster	https://www.dol.gov/agencies/whd/posters/flsa
2.	Davis-Bacon Wage Poster WH-1321	https://www.dol.gov/sites/dolgov/files/WHD/legacy/files/fedprojc.pdf
3.	Davis-Bacon Wage Determinations	https://sam.gov/search/?index=dbra&sort=-modifiedDate&page=1&pageSize=25&sfm%5Bstatus%5D%5Bis_active%5D=true&sfm%5BwdLocationWrapper%5D%5BwdStates%5D%5B0%5D%5Bkey%5D=UT&sfm%5BwdLocationWrapper%5D%5BwdStates%5D%5B0%5D%5Bvalue%5D=Utah&sfm%5BwdLocationWrapper%5D%5BwdCounty%5D%5B0%5D%5Bkey%5D=17773&sfm%5BwdLocationWrapper%5D%5BwdCounty%5D%5B0%5D%5Bvalue%5D=San%20Juan
4.	Equal Opportunity Employer Poster:	https://www.dol.gov/sites/dolgov/files/ofccp/regs/compliance/posters/pdf/eeopost.pdf
5.	OSHA Poster	https://www.osha.gov/publications/poster

DAVIS BACON PREVAILING WAGE REQUIREMENTS

“Notwithstanding any other provision of law and in a manner consistent with other provisions in this Act, all laborers and mechanics employed by contractors and sub-contractors on projects funded directly by or assisted in whole or in part by and through the Federal Government pursuant to this Act shall be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code. With respect to the labor standards specified in this section, the Secretary of Labor shall have the authority and functions set forth in Reorganization Plan Numbered 14 of 1950 (64 Stat. 1267; 5 U.S.C. App.) and section 3145 of title 40, United States Code.”

Federal Labor Standards Provisions (from 29 CFR 5.5)

(a) (1) *Minimum wages.*

- (i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

- (ii) (A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be

employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
- (2) The classification is utilized in the area by the construction industry; and
- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) *Withholding.* The project owner (the SRF loan recipient) or the Utah SRF Program shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the project owner or the Utah SRF Program may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) *Payrolls and basic records.*

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii) (A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the project owner. Project owner will provide copies to the Utah SRF Program upon request. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (*e.g.* , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the US Department of Labor/Wage and Hour Division Website at:

<https://www.dol.gov/sites/dolgov/files/WHD/legacy/files/wh347.pdf>. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the project owner. Project owner shall provide such information, upon request, to the Utah SRF Program or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the project owner or other government agencies.

(B) Each payroll submitted shall be accompanied by a “Statement of Compliance,” signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

- (C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the “Statement of Compliance” required by paragraph (a)(3)(ii)(B) of this section.
 - (D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.
- (iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the project owner, the Utah SRF Program, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) *Apprentices and trainees*

- (i) *Apprentices.* Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance

with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) *Trainees.* Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) *Equal employment opportunity.* The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) *Compliance with Copeland Act requirements.* The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) *Subcontracts.* The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the project owner

and/or the Utah SRF Program may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) *Contract termination: debarment.* A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) *Compliance with Davis-Bacon and Related Act requirements.* All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) *Disputes concerning labor standards.* Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(10) *Certification of eligibility.*

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(b) *Contract Work Hours and Safety Standards Act.* As used in this paragraph, the terms *laborers* and *mechanics* include watchmen and guards.

(1) *Overtime requirements.* No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) *Violation; liability for unpaid wages; liquidated damages.* In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor

responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

- (3) *Withholding for unpaid wages and liquidated damages.* The project owner or the Utah SRF Program shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.
- (4) *Subcontracts.* The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

Other related requirements and information

1. Based on 29 CFR 5.6(a)(3): Owner shall make such investigations as may be necessary to assure compliance with the labor standards provisions and related statutes and regulations. Investigations shall be made with such frequency as may be necessary to assure compliance. Such investigations shall include interviews with employees, which shall be taken in confidence, and examinations of payroll data and evidence of registration and certification with respect to apprenticeship and training plans. In making such examinations, particular care shall be taken to determine the correctness of classifications and to determine whether there is a disproportionate employment of laborers and of apprentices or trainees registered in approved programs. Such investigations shall also include evidence of fringe benefit plans and payments thereunder. Complaints of alleged violations shall be given priority.
2. A brief summary of required Davis Bacon compliance checking activities by Owner:
 - Make sure the Davis-Bacon poster and the wage determination are posted at the job site in a prominent and accessible place where both can be easily seen by the workers.
 - Review the weekly payrolls for compliance with the requirements.

- Interview employees to cross check the payrolls and to help ensure compliance with the requirements.
3. The regulations do not require a specific interval and number of employee interviews; however, Owner shall make the interval and number of interviews commensurate with the size and complexity of the project so as to provide a reasonable check on Contractor's compliance.
 4. The regulations do not require a specific interview format. Owner can use or adapt other agencies' Davis-Bacon interview forms, such as the one provided by the US Department of Housing and Urban Development, form HUD-11, which can be found at <https://www.hud.gov/sites/dfiles/OCHCO/documents/11.pdf> or Standard Form -1445 which can be found [at https://www.gsa.gov/cdnstatic/SF%201445.pdf?forceDownload=1](https://www.gsa.gov/cdnstatic/SF%201445.pdf?forceDownload=1).
 5. Owner shall maintain the payrolls, interview records, and other compliance related records for a minimum of three years after completion of the contract and shall provide them upon request to the Utah SRF Program or to applicable federal agencies.
 6. Additional compliance information and assistance is available at <https://www.dol.gov/agencies/whd/government-contracts/construction> and other related websites.
 7. Following are the **identifier codes** used to reference the various craft unions. Examples of classifications for which their local unions commonly negotiate wage and fringe benefit rates are shown in parentheses.

ASBE = International Association of Heat and Frost Insulators and Asbestos Workers

BOIL = International Brotherhood of Boiler Makers, Iron Shipbuilders, Blacksmiths, Forgers and Helpers

BRXX = International Union of Bricklayers, and Allied Craftsmen (bricklayers, cement masons, stone masons, tile, marble and terrazzo workers)

CARP = United Brotherhood of Carpenters and Joiners of America (carpenter, millwright, piledrivermen, soft floor layers, divers)

ELEC = International Brotherhood of Electrical Workers (electricians, communication systems installers, and other low voltage specialty workers)

ELEV = International Union of Elevator Constructors

ENGI = International Union of Operating Engineers (operators of various types of power equipment)

IRON = International Association of Bridge, Structural and Ornamental Iron Workers

- LABO = Laborers' International Union of North America
- PAIN = International Brotherhood of Painters and Allied Trades (painters, drywall finishers, glaziers, soft floor layers)
- PLAS = Operative Plasterers' and Cement Masons' International Association of the United States and Canada (cement masons, plasterers)
- PLUM = United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (plumbers, pipefitters, steamfitters, sprinkler fitters)
- ROOF = United Union of Roofers, Waterproofers and Allied Workers
- SHEE = Sheet Metal Workers International Association
- SU... = The "SU..." identifier is for rates derived from survey data where the union rate(s) were not determined to be prevailing for the classification(s) listed. (The data reported for such a classification and used in computing the prevailing rate may have included both union and non-union wage data.) Note that **various classifications**, for which non-union rates have been determined to be prevailing, may be listed in alphabetical order under this identifier, which the computer places into the wage determination in alphabetical order, as listed here.
- TEAM = International Brotherhood of Teamsters

PAYROLL
(For Contractor's Optional Use; See Instructions at www.dol.gov/esa/whd/forms/wh347instr.htm)



Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

OMB No.: 1215-0149
Rev. Dec. 2008
Expires: 12/31/2011

NAME OF CONTRACTOR OR SUBCONTRACTOR ADDRESS _____

PAYROLL NO. _____ FOR WEEK ENDING _____ PROJECT AND LOCATION _____ PROJECT OR CONTRACT NO. _____

(1) NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g., LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	(4) DAY AND DATE							(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS					(9) NET WAGES PAID FOR WEEK
			S	U	M	T	W	F	S				FICA	WITH-HOLDING TAX	OTHER	TOTAL DEDUCTIONS		
																	HOURS WORKED EACH DAY	

While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that it will take an average of 55 minutes to complete this collection, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, ESA, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W. Washington, D.C. 20210

(over)

Date _____

I, _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
(Contractor or Subcontractor)
_____ ; that during the payroll period commencing on the
(Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,
all persons employed on said project have been paid the full weekly wages earned, that no rebates have
been or will be made either directly or indirectly to or on behalf of said

_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly
from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part
3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948,
63 Stat. 108, 72 Stat. 967; 78 Stat. 357; 40 U.S.C. § 3145), and described below:

(2) That any payrolls otherwise under this contract required to be submitted for the above period are
correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the
applicable wage rates contained in any wage determination incorporated into the contract; that the
classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide
apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of
Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a
State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS.

— in addition to the basic hourly wage rates paid to each laborer or mechanic listed in
the above referenced payroll, payments of fringe benefits as listed in the contract
have been or will be made to appropriate programs for the benefit of such
employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

— Each laborer or mechanic listed in the above referenced payroll has been paid,
as indicated on the payroll, an amount not less than the sum of the applicable
basic hourly wage rate plus the amount of the required fringe benefits as listed
in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

Exception 8

NAME AND TITLE

SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR
SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE
31 OF THE UNITED STATES CODE.

The contract will be based on the most up-to-date wage rates available at the time the contract is signed. Up-to-date wage rates are found here:
If there is a wage rate covered by both Heavy and Building, then use the greater of the two wage rates.

"General Decision Number: UT20250076 07/18/2025

Superseded General Decision Number: UT20240076

State: Utah

Construction Type: Building

County: Sanpete County in Utah.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

<p>If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
<p>If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/03/2025
1	02/07/2025

2 03/07/2025
 3 05/23/2025
 4 07/18/2025

BOIL0004-001 01/01/2025

	Rates	Fringes
BOILERMAKER.....	\$ 44.37	26.87

* ELEC0354-001 06/11/2025

	Rates	Fringes
ELECTRICIAN (Low Voltage Wiring Only).....	\$ 31.86	1.5%+15.35
ELECTRICIAN.....	\$ 41.23	1.3%+17.12

SFUT0669-003 01/01/2025

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers).....	\$ 39.43	26.63

SHEE0312-001 07/01/2024

	Rates	Fringes
SHEET METAL WORKER (HVAC Duct Installation Only).....	\$ 44.74	13.64

* SUUT2012-008 07/29/2014

	Rates	Fringes
BRICKLAYER.....	\$ 23.88	0.00
CARPENTER (Acoustical Ceiling Installation Only).....	\$ 21.72	1.43
CARPENTER, Excludes Acoustical Ceiling Installation.....	\$ 16.98 **	0.00
CEMENT MASON/CONCRETE FINISHER...	\$ 21.11	0.00
INSULATOR - BATT.....	\$ 12.50 **	0.23
IRONWORKER, REINFORCING.....	\$ 15.00 **	0.00
IRONWORKER, STRUCTURAL.....	\$ 17.41 **	6.13
LABORER: Common or General.....	\$ 11.21 **	0.00
LABORER: Mason Tender - Brick...	\$ 16.54 **	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 16.59 **	0.79
PLUMBER.....	\$ 24.00	4.62
TILE FINISHER.....	\$ 17.00 **	0.00
TILE SETTER.....	\$ 20.63	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

=====
** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated

rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE:

UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The "SU" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The "SA" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can

be:

- a) a survey underlying a wage determination
- b) an existing published wage determination
- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
 Wage and Hour Division
 U.S. Department of Labor
 200 Constitution Avenue, N.W.
 Washington, DC 20210

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Branch of Construction Wage Determinations
 Wage and Hour Division
 U.S. Department of Labor
 200 Constitution Avenue, N.W.
 Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
 U.S. Department of Labor
 200 Constitution Avenue, N.W.
 Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
 U.S. Department of Labor
 200 Constitution Avenue, N.W.
 Washington, DC 20210.

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END OF GENERAL DECISION"

"General Decision Number: UT20250027 01/03/2025

Superseded General Decision Number: UT20240027

State: Utah

Construction Type: Heavy

County: Sanpete County in Utah.

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

<p>If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
<p>If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

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Modification Number Publication Date
 0 01/03/2025

TEAM0222-019 07/01/2024

Rates Fringes

TRUCK DRIVER (Articulated).....\$ 32.14	14.65
TRUCK DRIVER (Concrete Pumping).....\$ 29.62	14.65
TRUCK DRIVER (Dump Truck, Bottom-end or side)	
Less than 8 cu. yds.....\$ 29.37	14.65
8 cu. yds. to less than 14 cu. yds.....\$ 29.53	14.65
14 cu. yds. to less than 35 cu. yds.....\$ 29.67	14.65
35 cu. yds. to less than 55 cu. yds.....\$ 29.91	14.65
55 cu. yds. to less than 75 cu. yds.....\$ 30.12	14.65
75 cu. yds. to less than 95 cu. yds.....\$ 30.34	14.65
95 cu. yds. to less than 105 cu. yds.....\$ 30.56	14.65
105 cu. yds. to less than 130 cu. yds.....\$ 30.69	14.65
TRUCK DRIVER (Flat Rack, Bulk Cement, Semi-Trailers, Mud/Banding and Paint)	
Less than 10 tons.....\$ 29.26	14.65
10 tons to less than 15 tons.....\$ 29.42	14.65
15 tons to less than 20 tons.....\$ 29.53	14.65
20 tons and over.....\$ 29.69	14.65
Pickup Truck.....\$ 29.18	14.65
TRUCK DRIVER (Lowboy).....\$ 32.69	14.65
TRUCK DRIVER (Oil Spreader).....\$ 32.68	14.65
TRUCK DRIVER (Tiremen and Greaser).....\$ 30.19	14.65
TRUCK DRIVER (Transit Mix)	
0 cu. yds. to 8 cu. yds.....\$ 29.62	14.65
Over 8 cu. yds. to 14 cu. yds.....\$ 29.72	14.65
TRUCK DRIVER (Water, Fuel & Oil Tank)	
less than 1,200 gal.....\$ 29.24	14.65
1,200 gal. to less than 2,500 gal.....\$ 29.37	14.65
2,500 gal. to less than 4,000 gal.....\$ 29.53	14.65
4,000 gal. to less than 6,000 gal.....\$ 30.06	14.65
6,000 gal. to less than 10,000 gal.....\$ 30.12	14.65
10,000 gal. to less than 15,000 gal.....\$ 30.59	14.65
15,000 gal. to less than 20,000 gal.....\$ 30.66	14.65
20,000 gal. to less than 25,000 gal.....\$ 31.04	14.65
25,000 gal. and over.....\$ 31.20	14.65

 SUUT2008-029 08/19/2008

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...\$ 14.00 **		0.56
LABORER: Common or General.....\$ 11.86 **		1.28

LABORER: Mason Tender - Cement/Concrete.....	\$ 9.00 **	0.36
LABORER: Pipelayer.....	\$ 13.00 **	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 16.55 **	0.00
OPERATOR: Grader/Blade.....	\$ 14.08 **	0.00
OPERATOR: Loader (Front End)....	\$ 15.89 **	4.75
OPERATOR: Roller (Dirt and Grade Compaction).....	\$ 11.62 **	0.00

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

=====
 ** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

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The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a

supplemental classification rate.

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A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

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Union Average Rate Identifiers

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A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

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01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

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Washington, DC 20210

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Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

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interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION"

**MT PLEASANT
SEWER LAGOONS
NEW HEADWORKS
BUILDING**

Sanpete County, Utah

*Prepared for:
J-U-B Engineers*

December 2024

RB&G
ENGINEERING, INC.

December 30, 2024

J-U-B Engineers
Attn: Gary Vance, P.E., Program Manager
392 East Winchester Street, Suite 300
Salt Lake City, UT 84107

Re: Mt Pleasant Sewer Lagoons New Headworks Building – Geotechnical Investigation

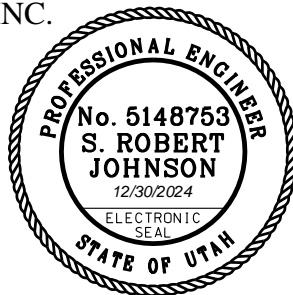
Dear Mr. Vance:

A Geotechnical Investigation has been completed for the proposed new headworks building at the Mt Pleasant Sewer Lagoon facility in Sanpete County, Utah. The results of this study are summarized in the report transmitted herewith.

We appreciate the opportunity of providing this service for you. If there are any questions relating to the information contained herein, please call.

Sincerely,

RB&G ENGINEERING, INC.



S. Robert Johnson, P.E., Principal

GEOTECHNICAL INVESTIGATION

**Mt Pleasant
Sewer Lagoons
New Headworks
Building**

Sanpete County, Utah

*Prepared for:
J-U-B Engineers*

December 2024

RB&G ENGINEERING, INC.

GEOTECHNICAL INVESTIGATION

MT PLEASANT SEWER LAGOONS
NEW HEADWORKS BUILDING
MT PLEASANT, UTAH

1 INTRODUCTION

This report outlines the results of a geotechnical investigation conducted for the proposed new headworks building at the sewer lagoons located southwest of Mt Pleasant, in Sanpete County, Utah.

The information contained in this report is discussed under the following headings: Geological and Existing Site Conditions, Subsurface Soil and Water Conditions, Foundation Recommendations, and Site Preparation and Compacted Fill Requirements.

2 GEOLOGICAL AND EXISTING SITE CONDITIONS

Figure 1 is an aerial vicinity map showing the location of the site relative to the surrounding area. The sewer lagoon site is bordered on the north by 1000 S street and on the west by 1650 W street (both unpaved), and on the southeast by the former Denver and Rio Grande Western railroad alignment. The Mt Pleasant Airport, which closed in 2016, was located on the east side of the rail line across from the sewer lagoons. The site includes two active sewer lagoon ponds with surface areas of about 13 to 20 acres each, and two smaller ponds (less than about 12 acres) which appear (from aerial photos dating back to 1985) to store water less frequently. The proposed headworks building is located near the northeast corner of the site, near the location of an existing shed with plan dimensions in the order of 10 by 12 feet.

The natural soils mapped across the site and near vicinity consist of Holocene to Pliocene coalesced alluvial-fan deposits formed by overlapping and interfingering of adjacent alluvial fans.

This unit forms broad, low, sloping aprons at the foot of adjacent highlands and generally include silt, sand, granules, pebbles, cobbles, and sparse boulders. The thickness of this unit is uncertain, but may be as great as about 100 feet locally. The San Pitch River flows from northeast to southwest across the valley floor about two miles northwest of the site, with a broad floodplain (approx. one mile wide) mapped as Holocene stream alluvium. The hills about two miles west of the site are mapped as limestone and shale of the Green River Formation (Eocene), and the mountains east of Mt Pleasant include Flagstaff Limestone (Eocene and Paleocene) and fluvial rocks of the North Horn Formation (Paleocene to Upper Cretaceous). No faults are known to cross the site. The Fairview Diapiric(?) Fold is inferred on the geologic map as crossing through the valley about ¼-mile east of the site. This feature has been attributed to possible flexural failure of rocks along a fault lining the west flank of the Wasatch Plateau, which is theorized to have opened a conduit for the rise of confined and compressed salt which formed the fold.¹

The nearest quaternary fault is the Gunnison fault, located about 9 miles west of the site near the base of the San Pitch Mountains. Several older faults are located within the Wasatch Plateau and associated mountain ranges east of Mt Pleasant.

The natural terrain at site is relatively flat with the ground sloping gently down to the west toward the San Pitch River. We have not reviewed existing plans nor topographic survey data for the sewer lagoons, but field observations estimate they may be excavated about 15 feet below the natural ground surface elevation at the site. Site vegetation consists of sparse weeds and grass cut down by grazing of livestock. At the time of our field investigations (November 14, 2024), the adjacent sewer lagoon was full and water was flowing in an irrigation ditch along the north side of 1000 S street, roughly 250 feet north of the proposed building site. A review of the Utah Division of Water Rights water well map server shows more than a dozen water wells have been drilled within a 5,000-foot radius of the site, and the well logs indicate water-bearing coarse grained soils (sands and gravels) were often encountered at various depths between about 30 and 100 feet below the ground surface.

No indications were noted of substandard foundation performance of the minor existing structure on the site. The aged concrete flatwork lining the north side of the existing headworks/inlet appears to have experienced some settlement.

¹ *Geologic Map of the Nephi 30' x 60' Quadrangle, Carbon, Emery, Juab, Sanpete, Utah, and Wasatch Counties, Utah*, 1991, by Irving J. Witkind and Malcolm P. Weiss, U.S. Geological Survey Map I-1937.

Other than the information provided above, no surface conditions appear to exist at the site which would adversely affect foundation performance.

3 SUBSURFACE SOIL AND WATER CONDITIONS

The characteristics of the subsurface material were evaluated by drilling and sampling in one geotechnical boring which extended to a depth of 35 feet below the existing ground surface. The approximate location of this boring is shown on Figure 2. The log for the boring is included in the appendix. The longitude and latitude shown on the log were estimated from hand-held equipment and/or online mapping tools and should be considered approximate.

Details of the methods, equipment, and tooling used in the subsurface exploration are included in the appendix to this report.

The soil profile encountered in Boring 24-1 included gravel with silt and sand (USCS symbol GP-GM) fill in the upper 8 inches, underlain by sandy lean clay (CL) to lean clay with sand to a depth of about 5 feet below the existing ground surface. This clay layer was very stiff, with an unconfined compressive strength of about 4,000 psf and a pocket penetrometer value greater than 4.5 tsf. The dry density of an intact sample of the clay was 101.2 pcf. This sample had a liquid limit of 30, a plasticity index of 13, and a moisture content of 15 percent. A gradation test conducted on the clay resulted in 1 percent gravel, 25 percent sand, and 74 percent finer than the 200 (0.075-mm) sieve.

The compressibility characteristics of the clay were evaluated by performing a consolidation test on the sample obtained between depths of 3 and 4 feet. The test results suggest the clay is normally consolidated, and subject to significant compression under loading exceeding about 1,000 psf. During the consolidation test, the sample was inundated and permitted to absorb water after the initial 0.25-tsf loading was applied to evaluate the effects of moisture on its compressibility characteristics. Expansive soils experience an increase in void ratio upon absorbing water, while collapsible soils exhibit an abrupt decrease in void ratio upon wetting. The sample tested for this project did not exhibit expansive nor collapsible characteristics.

The resistivity, pH, chloride content, sulfate content, and soluble salt content were tested to evaluate electrochemical characteristics of the lean clay obtained immediately beneath the surficial gravel fill. The tested sample tested had a pH of 8.0, resistivity of 2,500 ohm-cm, water-soluble chloride content of 42 mg/kg-dry (ppm), water-soluble sulfate content of 30 mg/kg-dry., and 2.82 percent soluble salts.

Below the clay, the boring encountered predominantly granular soils consisting of clayey sand (SC), silty sand (SM), silty clayey sand (SC-SM), and silty gravel (GM); however, a layer of sandy silt (ML) up to about 2 feet thick was noted between depths of 12 and 14 feet. Standard Penetration Test (SPT) blow counts in the sands and gravels suggest they are relatively dense to very dense. The sands and gravels were observed to be partially indurated (cemented or hardened) and bordering on weathered and/or crushed sandstone with increasing depth in the boring. Indications of possible cobbles and boulders were noted within this zone. Drilling and sampling observations made between depths of about 23 and 35 feet suggested sandstone bedrock may exist within these depths.

The sandy silt (ML) obtained at a depth of about 12.5 feet had a dry density of 110.3 pcf, a moisture content of 15.4 percent, and gradation characteristics of 1 percent gravel, 40 percent sand, and 59 percent non-plastic fines. An unconfined compression test was conducted on this sample to a failure load of 544 psf.

The partially indurated silty sand (SM) with gravel at 20 feet had a moisture content of 10.2 percent, with 34 percent gravel, 40 percent sand, and 26 percent finer than the No. 200 sieve. The silty clayey sand (SC-SM) with gravel (possible bedrock) at 30 feet had a moisture content of 7.2 percent, a liquid limit of 18, and a plasticity index of 4, and contained 36 percent gravel, 43 percent sand, and 21 percent fines.

The depth to groundwater was initially measured at about 20 feet below the ground surface upon completion of drilling, and had fallen below 33 feet before the geologist left the project site. A 1-inch diameter slotted PVC pipe was left in the boring to allow further verification of subsurface groundwater conditions if desired.

4 ENGINEERING ANALYSIS AND RECOMMENDATIONS

4.1 SEISMIC CONSIDERATIONS

The site is located at latitude 39.53121° North and longitude 111.47864° West. Based upon the site subsurface conditions and mapped geology, we recommend Site Class D be used for seismic design in accordance with ASCE 7.

The following table lists the calculated seismic design parameters in accordance with ASCE 7-16.²

Parameter	Value	Description
S_S :	0.591	MCE_R ground motion (period 0.2s)
S_I :	0.194	MCE_R ground motion (period 1.0s)
F_a :	1.328	Site Class D site amplification factor (period 0.2s)
F_v :	2.212	Site Class D site amplification factor (period 1.0s)
S_{MS} :	0.784	Site-modified spectral acceleration value (period 0.2s)
S_{M1} :	0.429	Site-modified spectral acceleration value (period 1.0s)
S_{DS} :	0.523	Numeric seismic design value at 0.2s SA
S_{D1} :	0.286	Numeric seismic design value at 1.0s SA
T_L :	8 seconds	Long-period transition period
PGA :	0.266	MCE_G peak ground acceleration
PGA_M :	0.354	Site-modified peak ground acceleration
F_{PGA} :	1.334	Site Class D site amplification factor for PGA

The site peak ground acceleration for liquefaction design (PGA_M) is greater than 0.30g, and could cause liquefaction in relatively loose saturated granular soils. However, the potential for significant liquefaction to affect seismic performance of the site facilities is low because (1) the granular soils within the depth investigated are relatively dense and/or indurated, and (2) groundwater does not appear to exist within 30 feet of the ground surface.

4.2 FOUNDATION TYPES AND BEARING CAPACITIES

We understand preliminary plans for this anticipate a concrete masonry block building with a slab on grade floor near the existing ground surface elevation and a rectangular footprint measuring approximately 40 feet by 20 feet. It has been assumed in preparing this report that wall foundation loads will not exceed 2 kips per foot.

We recommend all exterior foundations be located at a depth below finished grade sufficient to provide frost protection, which is about 2.5 feet in this area. We recommend all footings be at least 24 inches wide.

Although the sulfate content test performed for this investigation indicates low potential for sulfate attack in the native site soils, we recommend Type II Portland cement (or an equivalent blended cement with moderate sulfate resistance) be used for concrete that will be in contact with the site soils. The resistivity and chloride test results suggest the natural site soils are relatively non-aggressive in terms of corrosion; however, selection of piping and other potentially metallic project

² <https://asce7hazardtool.online/>

components should also consider potential corrosivity of wastewater, as well as the possible use of de-icing salts once the facility and site are developed further.

The native clay soils in the upper 5 feet of the soil profile are relatively stiff, with an allowable bearing capacity of about 4,000 psf. However, we recommend the allowable bearing capacity for design of structural foundations supported directly on the native clay soils be limited to 1,000 psf to minimize settlements of the footings. For the minimum recommended footing width of 2 feet, the allowable bearing capacity for design may be increased to 1,500 psf by placing a 12-inch thickness of structural fill beneath the footings, to 1,750 psf with 18 inches of structural fill, or to 2,000 psf with 24 inches of structural fill.

Recommended bearing resistance for foundations wider than 2 feet placed on structural fill can be provided if needed. The width of the over-excavation and structural fill section beneath the footing should extend at least $0.6z$ beyond the footing on all sides, where z is the thickness of the structural fill placed beneath the footing. For example, a 2-foot wide footing designed using an allowable bearing capacity of 1,500 psf should be placed on structural fill measuring at least 12 inches thick and at least 3.2 feet wide, with the footing centered over the structural fill.

The structural fill should consist of relatively well graded sandy gravel having a maximum size of 3 inches, with between 5 and 20 percent passing a No. 200 sieve. At least 70 percent should be finer than $\frac{3}{4}$ inch. The portion passing the No. 40 sieve should have a plasticity index less than 6. Structural fill should be placed in lifts no thicker than 12 inches (loose thickness), moisture conditioned to within 2 percent of the optimum moisture content, and compacted to an in-place dry unit weight of at least 95 percent of the maximum laboratory density as determined by ASTM D 1557.

4.3 LATERAL EARTH PRESSURES

It is not anticipated that earth-retaining structures will be required for the proposed facility. If earth-retaining structures are required, however, and if backfilling is performed using granular material and the backfill behind the wall is finished to be horizontal (i.e., no surcharge nor backslope behind the wall), we recommend that the earth pressures be calculated using the following equation, along with the earth pressure coefficient outlined below:

$$P = \frac{1}{2} \gamma K H^2$$

Where P = total lateral force on wall, plf
 K = earth pressure coefficient
 γ = unit weight of soil (130 pcf)
 H = height of retained soil against wall

The earth pressure coefficient appropriate for use in designing retaining structures depends on whether the wall is free to move or restrained during backfilling operations. If the wall is free to move during backfilling operations and the backfill material is granular soil, we recommend an active earth pressure coefficient of 0.30 be used in the above equation to calculate the lateral earth pressures. If the wall is restrained from any movement during backfilling and the backfill material is granular soil, we recommend an at-rest earth pressure coefficient of 0.45 be used to calculate the lateral earth pressure. We recommend a passive earth pressure coefficient of 3.3 be used where the granular soil is used to restrain lateral movement.

For the design seismic event, the additional active earth pressure due to ground acceleration may be estimated using a coefficient of 0.12. The seismic ground motion will reduce the available passive resistance. This reduction may be accounted for as an earth pressure acting in the direction opposite the passive resistance and computed using a coefficient of 0.3. The pressure diagrams for these forces may be roughly approximated as inverted triangles, such that the resultant forces of the seismic components act at heights of approximately $2H/3$ above the base of the wall.

It should be recognized that the pressures calculated by the above equation are earth pressures only and do not include hydrostatic pressures. Where hydrostatic pressures may exist behind a retaining structure, we recommend either the wall be designed to resist hydrostatic pressure, or a drainage system be placed behind the wall to prevent the development of hydrostatic pressures.

4.4 FLOOR SLABS

We recommend that at least 8 inches of granular fill be placed under the slab-on-grade floor. The granular fill should have a maximum size of 2 inches and non-plastic fines. If this recommendation is complied with, a free draining granular layer beneath floor slabs is not required. An alternative is to use site grading fill (see Section 5 below) for the bottom half of the granular layer and replace the top 4 inches with free draining gravel. The free draining layer should have a maximum size less than 1 inch and not more than 5 percent passing the No. 200 sieve. The free draining material should be densified using at least 4 passes of a smooth drum 5-ton vibratory roller or equivalent. If the above specifications are followed, the granular layer will prevent the accumulation of moisture beneath the floor slab and will also serve adequately as a base beneath the floor slabs.

If moisture-sensitive flooring, such as tile, is planned for slab-on-grade floors, a vapor retarder/barrier should be placed directly beneath the concrete floor slab in lieu of a free-draining granular layer. The vapor barrier should meet ASTM E 1745 Class A requirements.

A subgrade modulus of 150 pci may be assumed for design of slab-on-grade concrete floors.

5 SITE PREPARATION AND COMPACTED FILL REQUIREMENTS

We recommend the upper 8 inches be stripped from the area to remove excessive organic matter in the upper portion of the soil profile. Brush, including roots, should be removed where encountered within building area and adjacent areas to receive flatwork or pavement.

Project excavations should be performed with a smooth-edged bucket to avoid disturbing the subgrade clayey soils that will remain in place beneath structures and compacted fill. Where disturbance occurs or is observed at the foundation subgrade level during excavation, the foundation area should be over-excavated and replaced with structural fill. We recommend a qualified geotechnical engineer observe all footing excavations to help identify any disturbed soils that should be replaced before placement of foundation reinforcement and concrete. To help ensure uniform support exists across the bearing surface where over-excavation is performed, a uniform thickness of structural fill should be placed beneath the entire footprint of a given footing.

Imported fill used to establish final grade, if needed should consist of granular soil having a maximum size of 6 inches, with less than 20 percent passing the No. 200 sieve. At least 70 percent should be finer than $\frac{3}{4}$ inch. The material passing a No. 40 sieve should have a plasticity index less than 6. The fill should be compacted to an in-place density equal to at least 92 percent of the maximum density as determined by ASTM D 1557. Structural fill beneath foundations should meet requirements outlined in Section 4.2.

Grading around the structure should be performed in such a manner that all surface water will flow freely away from the building and no ponding will occur adjacent to the structure. Failure to comply with these recommendations will permit deep percolation into the foundation area which may contribute to settlement. Roof drains should extend well beyond the building lines, and sprinkler heads or any other sources of water located near the building should be directed away from the structure.

Backfilling around foundations and walls should be performed using granular materials densified to an in-place unit weight equal to at least 90% of the maximum laboratory density indicated above.

6 LIMITATIONS

The conclusions and recommendations presented in this report are based upon the results of field and laboratory tests which, in our opinion, define the characteristics of the subsurface material

throughout the site in a satisfactory manner. It should be recognized that soil materials are inherently heterogeneous and that conditions may exist throughout this site which could not be defined during this investigation.

Since the bearing capacity of foundations will depend upon minimizing disturbance of the subgrade soils left in place, and upon adequate compaction of structural fill, it is recommended that we be given the opportunity to observe the foundation excavations and review compaction test records for any structural fill before the footings are placed.

If conditions are encountered during construction which appear to be different from those presented in this report, it is requested that we be advised so that appropriate action may be taken.

The information contained in this report is provided for the specific location and purpose of the client named herein and is not intended or suitable for reuse by any other person or entity, whether for the specified use or for any other use. Any such unauthorized reuse by any other party is at that party's sole risk and RB&G Engineering, Inc. does not accept any liability or responsibility for its use.

FIELD AND LABORATORY TESTING PROCEDURES

The subsurface investigation was performed using a CME 55 rotary drill rig, with NW casing and a 2-15/16" rock bit (rotary wash method) used to advance the boring and water as the drilling fluid. During the subsurface investigation, sampling for the structure borings was performed at 3-foot depth intervals in the upper 15 feet and at 5-foot intervals thereafter.

Disturbed samples were obtained by driving a 2-inch OD or 2.5-inch OD split spoon sampling tube a depth of 18 inches, using a 140-pound weight dropped from a height of 30 inches by an automatic trip hammer. The number of blows required to drive the sampling spoon through each 6 inches of penetration is shown on the boring logs.

The sum of the last two blow counts, which represents the number of blows recorded while driving the sampling spoon through 12 inches, is defined as the standard penetration value. The standard penetration value, corrected for overburden soil pressure and hammer energy, provides a good indication of the in-place density of sandy material; however, it only provides an indication of the relative stiffness of the cohesive material, since the penetration resistance of materials of this type is a function of the moisture content.

Considerable care must be exercised in interpreting the standard penetration value in gravelly-type soils, particularly where the size of the gravel particle(s) exceeds the inside diameter of the sampling spoon. If the spoon can be driven through the full 18 inches with a reasonable sample recovery, the standard penetration value provides a good indication of the in-place density of gravelly-type material.

Relatively undisturbed samples were obtained at selected depths by pushing a thin-walled sampling tube into the soil using the hydraulic pressure on the drill rig. Depths at which undisturbed sampling was attempted are shown on the boring log.

Pocket penetrometer tests, which provide an indication of the unconfined compressive strength of cohesive soils were performed on selected samples of stiff cohesive materials. The results of these field strength tests are shown on the boring logs in units of tons per square foot.

Each sample obtained in the borings was classified in the laboratory according to the Unified Soil Classification System. Symbols designating the soil types according to this system are presented on the logs. A description of the Unified Soil Classification System is included in the appendix, and the meanings of the various symbols shown on the logs can be obtained from this figure.

Testing was performed following procedures outlined in the ASTM International standards.

FIGURES

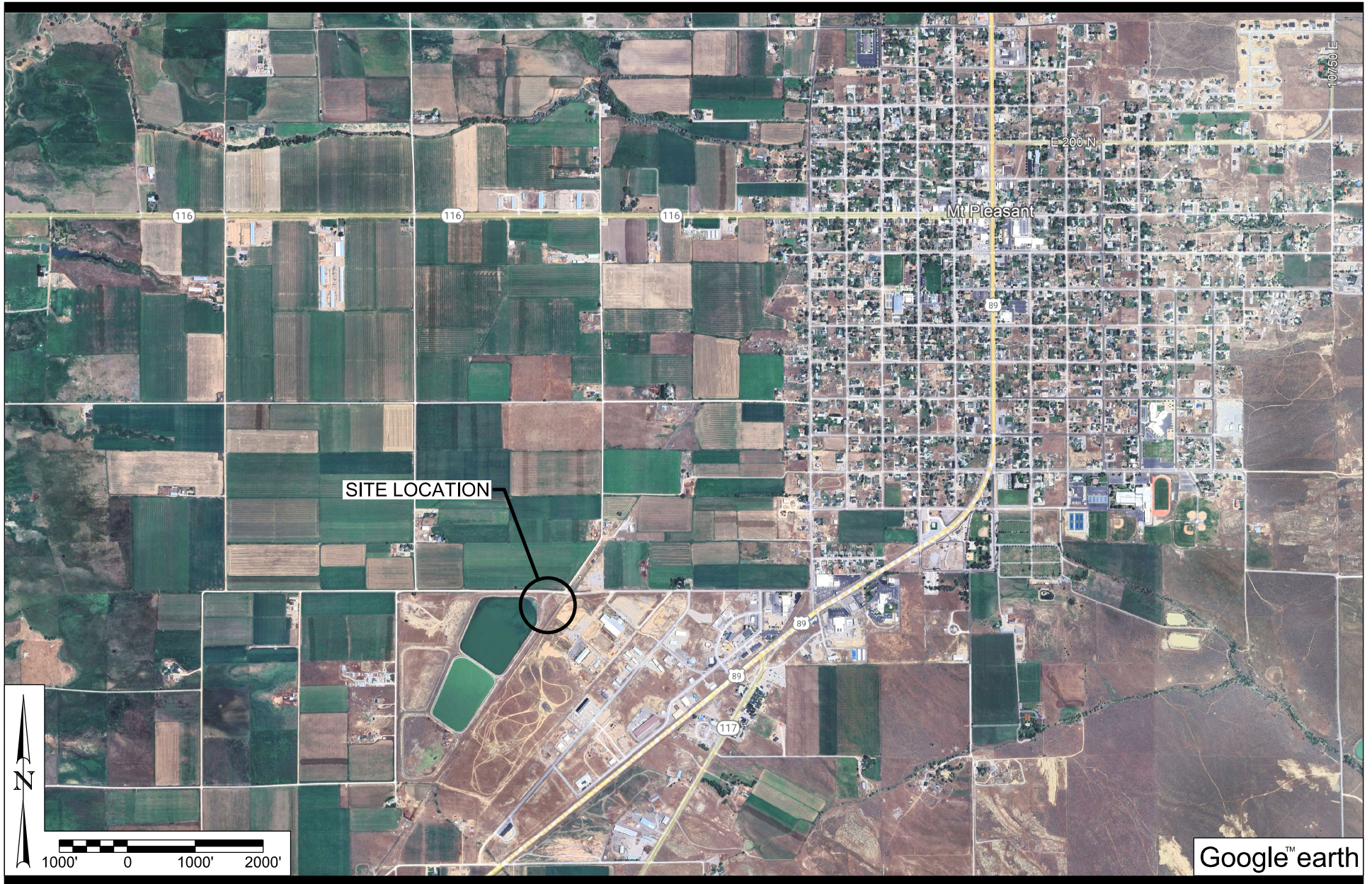


Figure 1 VICINITY MAP
Mt. Pleasant Sewer Lagoons Headworks Building
Mt. Pleasant, Sanpete County, Utah

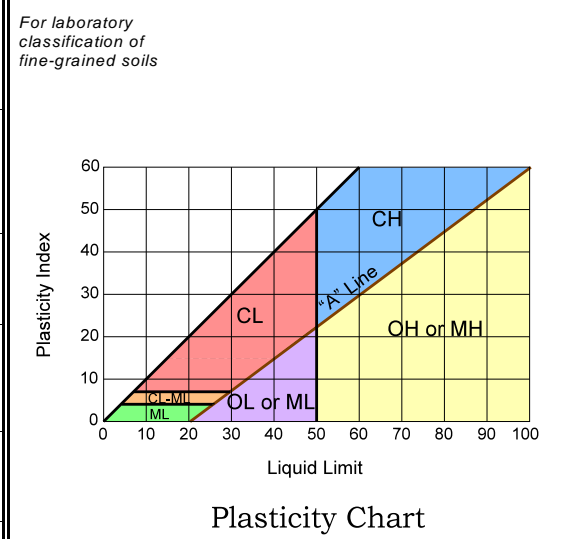


Figure 2 SITE PLAN & TEST HOLE LOCATION
Mt. Pleasant Sewer Lagoons Headworks Building
Mt. Pleasant, Sanpete County, Utah

APPENDIX

Unified Soil Classification System

Major Divisions		Group Symbols	Typical Names	Laboratory Classification Criteria				
COARSE-GRAINED SOILS <i>more than half of material is larger than No. 200 sieve</i>	Gravels <i>more than half of coarse fraction is larger than No. 4 sieve size</i>	Clean Gravels <i>little or no fines</i>	GW Well graded gravels, gravel-sand mixtures, little or no fines	<i>For laboratory classification of coarse-grained soils</i> $C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	Determine percentage of gravel and sand from grain-size curve.			
		Gravels With Fines <i>appreciable amount of fines</i>	GP Poorly graded gravels, gravel-sand mixtures, little or no fines			GM*	d Silty gravels, poorly graded gravel-sand-silt mixtures	
			u Clayey gravels, poorly graded gravel-sand-clay mixtures					
		Sands <i>more than half of coarse fraction is smaller than No. 4 sieve size</i>	Clean Sands <i>little or no fines</i>			SW Well graded sands, gravelly sands, little or no fines	<i>Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:</i> Less than 5% GW, GP, SW, SP 5% to 12% Borderline cases requiring use of dual symbols**	Not meeting all gradation requirements for GW
	Sands with Fines <i>appreciable amount of fines</i>		SP Poorly graded sands, gravelly sands, little or no fines	SM*	d Silty sands, poorly graded sand-silt mixtures			
			u Clayey sands, poorly graded sand-clay mixtures					
	Silts and Clays <i>liquid limit is less than 50</i>		ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	SC	SC Clayey sands, poorly graded sand-clay mixtures	Atterberg limits below "A" line, or PI less than 4		
			CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays					
			OL Organic silts and organic silt-clays of low plasticity					
		OH Organic clays of medium to high plasticity, organic silts						
Silts and Clays <i>liquid limit is greater than 50</i>	MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	CH	CH Inorganic clays of high plasticity, fat clays	Atterberg limits above "A" line, or PI greater				
	CH Inorganic clays of high plasticity, fat clays							
	OH Organic clays of medium to high plasticity, organic silts							
	OH Organic clays of medium to high plasticity, organic silts							
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils					



*Division of **GM** and **SM** groups into subdivisions of **d** and **u** for roads and airfields only. Subdivision is based on Atterberg limits; suffix **d** used when liquid limit is 28 or less and the PI is 6 or less, the suffix **u** used when liquid limit is greater than 28.

***Borderline classification*: Soils possessing characteristics of two groups are designated by combinations of group symbols. (For example **GW-GC**, well graded gravel-sand mixture with clay biner.)

DRILL HOLE LOG

BORING NO. 24-1

PROJECT: **MT. PLEASANT SEWER LAGOON HEADWORKS BUILDING**

SHEET 1 OF 1

CLIENT: **JUB ENGINEERS**

PROJECT NUMBER: **202401-043**

LOCATION: **APPROX. LAT: 39.53121° N, LONG: 111.47864° W**

DATE STARTED: **11/14/24**

DRILLING METHOD: **20-CME-55 / NW CASING TO 20'**

DATE COMPLETED: **11/14/24**

DRILLER: **S.W., S.J.**

GROUND ELEVATION: _____




DEPTH TO WATER - INITIAL: **▽ 33.2'** AFTER 24 HOURS: **▽ N.M.**

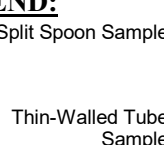
LOGGED BY: **M.N.H., J.B.**






Elev. (ft)	Depth (ft)	Lithology	Sample			Material Description	Dry Density (pcf)	Moisture Content (%)	Atter.		Gradation			Other Tests
			Type	Rec. (in)	See Legend				USCS (AASHTO)	Liquid Limit	Plast. Index	Gravel (%)	Sand (%)	
			14	12,12,9,(49)	GP-GM CL	lt. brown, sl. moist dk. brown, sl. moist, very stiff GRAVEL W/SILT & SAND (fill) SANDY LEAN CLAY								Chem.
	5		8	Pushed PP >4.5	CL	brown, moist, very stiff LEAN CLAY W/SAND trace organics	101.2	15.0	30	13	1	25	74	CT UC 4,080 psf
			14	9,39,50,(99+)	SC SM	lt. brown, moist CLAYEY SAND W/GRAVEL lt. brown to yellow-brown, sl. moist, very dense SILTY SAND W/GRAVEL TO SANDSTONE highly weathered, possible cobbles, boulders								
	10		17	10,8,15,(40)	SM	lt. brown, moist, dense SILTY SAND slightly plastic fines, white stringers, partially indurated								
			9	Pushed	SM ML	lt. brown, moist brown, moist SANDY SILT	110.3	15.4		NP	1	40	59	UC 544 psf
	15		3	Pushed 21,50/3"	GM GM	lt. brown, very moist lt. brown, very moist, very dense SILTY GRAVEL W/SAND possible cobbles, some partially indurated layers								
	20		9	17,60/3"	SM	lt. brown, very moist, very dense SILTY SAND W/GRAVEL possible cobbles, partially indurated		10.2		NP	34	40	26	
	25		4	60/4"	GM	yellow-brown, moist, very dense SANDSTONE (SILTY GRAVEL W/SAND) possible cobbles, boulders, bedrock?								
	30		15	31,44,57,(99+)	SC-SM	rusty-yellow-brown, moist, very dense SILTY CLAYEY SAND W/GRAVEL possible cobbles, bedrock?		7.2	18	4	36	43	21	
	35		0	60/1"	-	no recovery BOTTOM OF HOLE								

DH LOG V8-2014-1 MP SEWER LAGOON.GPJ US EVAL.GDT 12/30/24

LEGEND:

-  2" OD Split Spoon (SPT) Split Spoon Sample
-  2.5" OD Split Spoon
-  3" OD Split Spoon

-  Thin-Walled Tube Sample

-  Blow Count per 6" (N₆₀) Value
-  T 0.45 Torvane (tsf)
-  PP 2.0 Pocket Penetrometer (tsf) With Liners
-  Pushed T 0.45 Torvane (tsf)
-  PP 2.0 Pocket Penetrometer (tsf)

OTHER TESTS

- UC = Unconfined Compression
- CT = Consolidation
- DS = Direct Shear
- UU = Unconsolidated, Undrained
- CU = Consolidated, Undrained
- Chem. = pH, Resistivity, Sulfate, Chloride, Soluble Salts
- Hyd. = Hydrometer
- DC = Dispersive Clay



Table 1

SUMMARY OF TEST DATA

PROJECT Mt Pleasant Sewer Lagoons
 LOCATION Headworks
 see site plan

PROJECT NO. 202401-043
 FEATURE Foundations

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	IN-PLACE		UNCONFINED OR UU TRIAXIAL COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			PERCENT FINER THAN 0.005 mm	UNIFIED SOIL CLASSIFICATION SYSTEM
		DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY		
24-1	3-4.5	101.2	15.0	UC 4,080	30	17	13	1	25	74		CL
	12-13.5	110.3	15.4	UC 544			NP	1	40	59		ML
	20-21		10.2				NP	34	40	26		SM
	30-31.5		7.2		18	14	4	36	43	21		SC-SM
HOLE NO.	DEPTH (ft)	pH	RESISTIVITY (ohm-cm)	SULFATES (mg/kg-dry)	CHLORIDES (mg/kg-dry)	SOLUBLE SOLIDS (%)						
24-1	0	8.0	2,500	30	42	2.82						

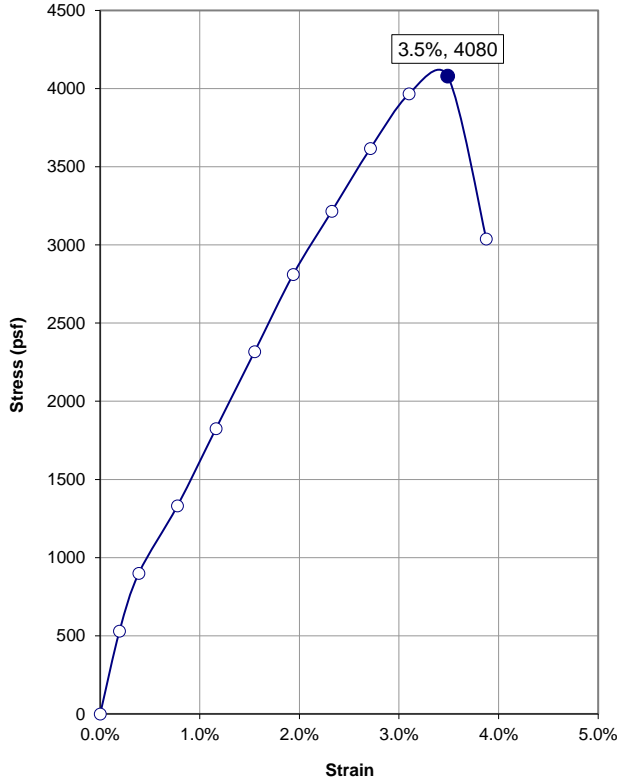
NP=Non-Plastic

UNCONFINED COMPRESSION TEST ON COHESIVE SOILS

Project Mt Pleasant Sewer Lagoon Headworks
Project No. 202401-043
Location See Site Plan
Date Friday, November 22, 2024
Tested By S Neil

Boring No. 24-1
Sample 1
Depth / Elev. (ft) 3-4.5'
Sample Description Lean Clay w/ Sand CL
Sample Type Undisturbed (shelby)

Apparatus No.	UC-1	Proving Ring No.	5552
----------------------	------	-------------------------	------



Total Strain	Stress (psf)	Sketch of Specimen After Failure
0.0%	0	
0.2%	529	
0.4%	900	
0.8%	1331	
1.2%	1826	
1.6%	2318	
1.9%	2812	
2.3%	3216	
2.7%	3618	
3.1%	3967	
3.5%	4080	
3.9%	3039	

Initial Sample Data

Initial height of specimen	L_o	5.16	(in)	Liquid limit	LL	30
Initial diameter of specimen	D_o	2.6	(in)	Plastic index	PI	13
Height-to-diameter ratio	L_o / D_o	1.98		Moisture content*	w	15.0%
Dry unit weight	γ_d	100.1	(pcf)			

Test Results

Unconfined compressive strength	q_u	4080	(psf)
Shear strength	τ_f	2040	(psf)
Average strain rate to failure		1%	
Strain at failure		3.5%	

Remarks _____

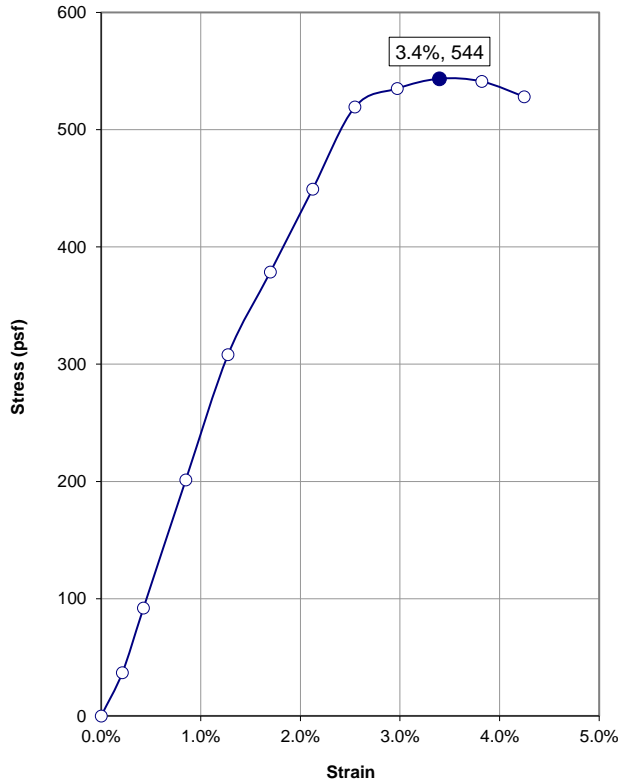
*Moisture content obtained from cuttings and or excess material

**UNCONFINED COMPRESSION TEST
ON COHESIVE SOILS**

Project Mt Pleasant Sewer Lagoon Headworks
Project No. 202401-043
Location See Site Plan
Date Friday, November 22, 2024
Tested By S Neil

Boring No. 24-1
Sample 1
Depth / Elev. (ft) 12-13.5'
Sample Description Sandy Silt ML
Sample Type Undisturbed (shelby)

Apparatus No.	UC-1	Proving Ring No.	5552
----------------------	------	-------------------------	------



Total Strain	Stress (psf)	Sketch of Specimen After Failure
0.0%	0	
0.2%	37	
0.4%	92	
0.8%	201	
1.3%	308	
1.7%	379	
2.1%	449	
2.5%	519	
3.0%	535	
3.4%	544	
3.8%	541	
4.2%	528	

Initial Sample Data

Initial height of specimen	L_o	4.71	(in)	Liquid limit	LL	NP
Initial diameter of specimen	D_o	2.5	(in)	Plastic index	PI	NP
Height-to-diameter ratio	L_o / D_o	1.88		Moisture content*	w	15.4%
Dry unit weight	γ_d	110.3	(pcf)			

Test Results

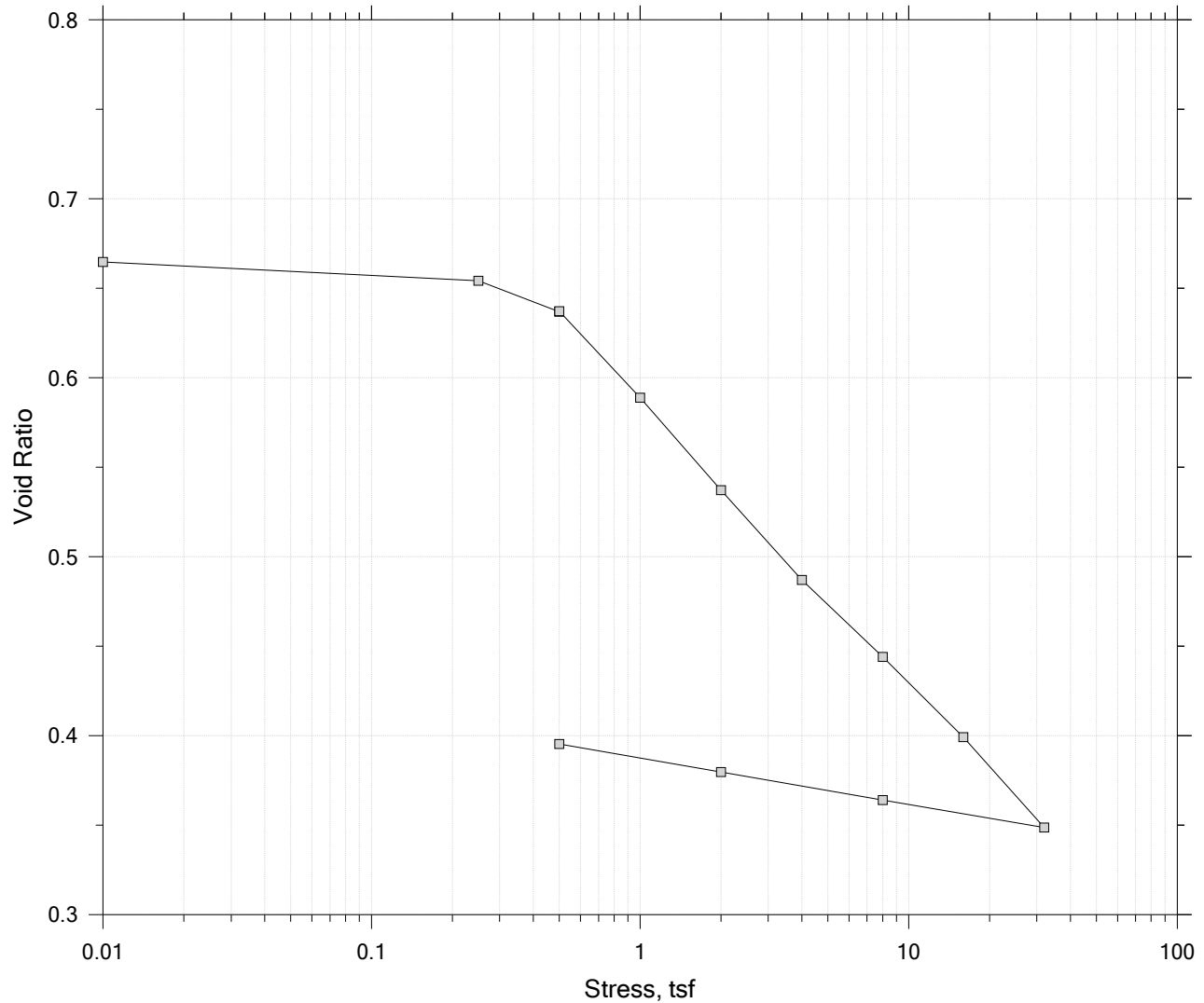
Unconfined compressive strength	q_u	544	(psf)
Shear strength	τ_f	272	(psf)
Average strain rate to failure		1%	
Strain at failure		3.4%	

Remarks Sample extruded out of shelby tube was smaller in diameter than the shelby tube.

*Moisture content obtained from cuttings and or excess material

Consolidation Test

Summary Report

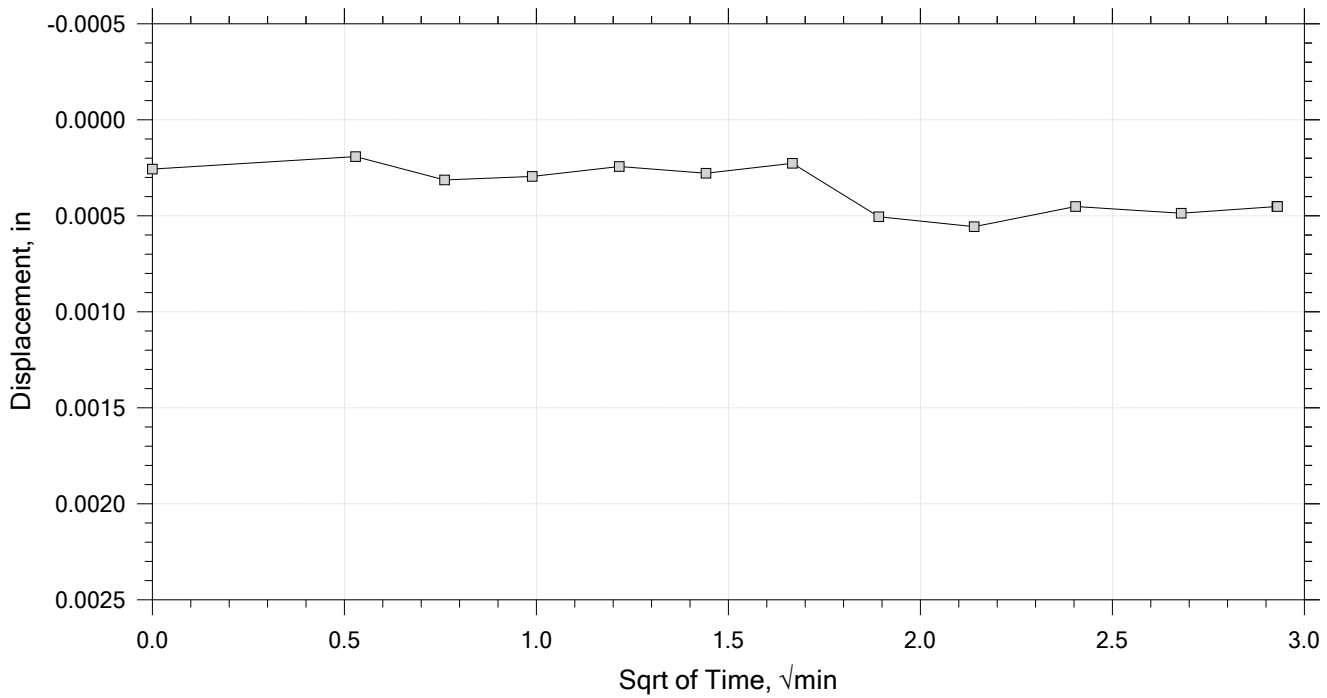
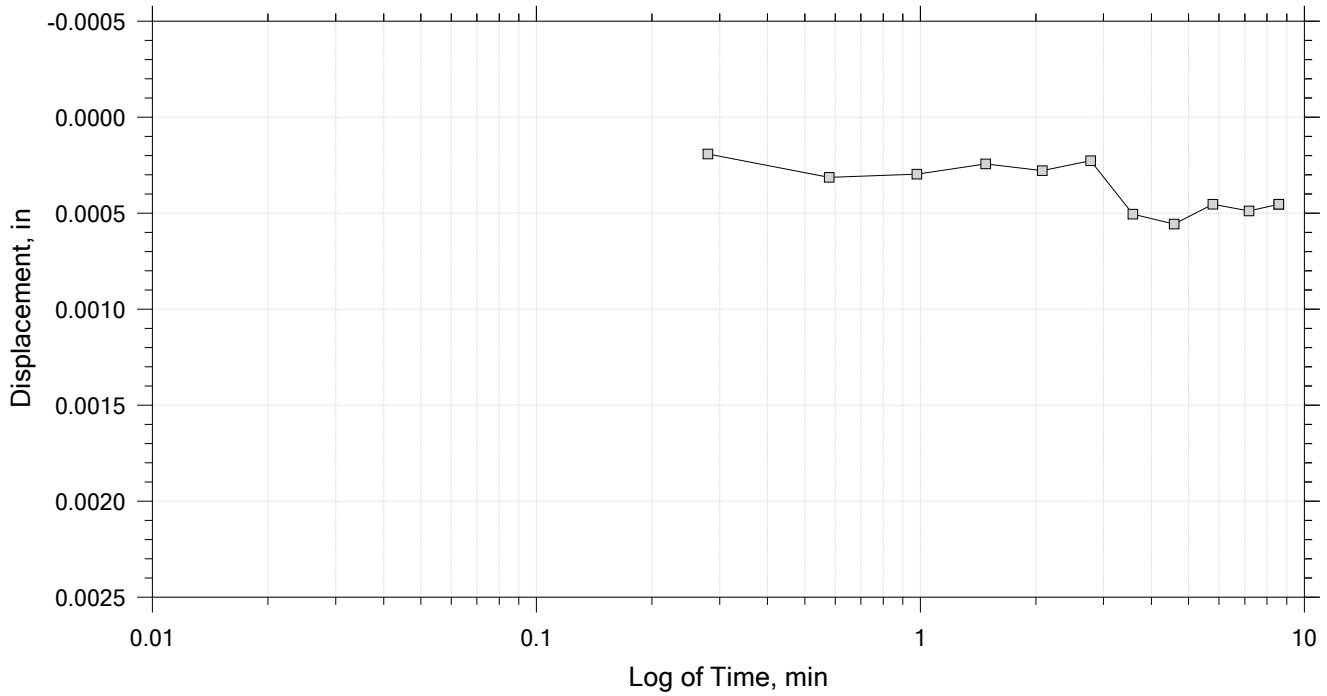


				Before Test	After Test	
Current Vertical Effective Stress, tsf: ---				Water Content, %	15.00	12.91
Preconsolidation Stress, tsf: ---				Dry Unit Weight, pcf	101.2	120.81
Compression Ratio: ---				Saturation, %	60.86	88.18
Specimen Diameter, in: 2.37		Specimen Height, in: 0.913		Void Ratio	0.67	0.40
LL: 30	PL: 17	PI: 13	GS: 2.70	Back Pressure, tsf	0.29952	0.29952

Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		
Displacement at End of Increment		

Consolidation Test

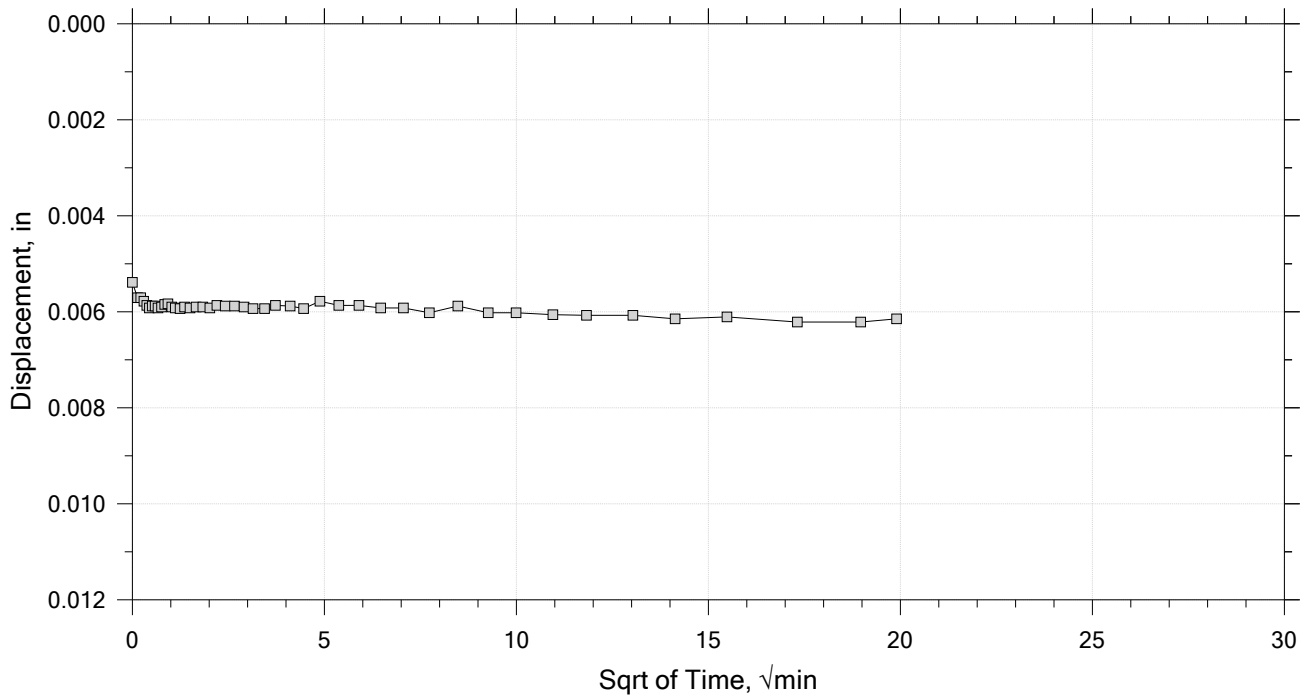
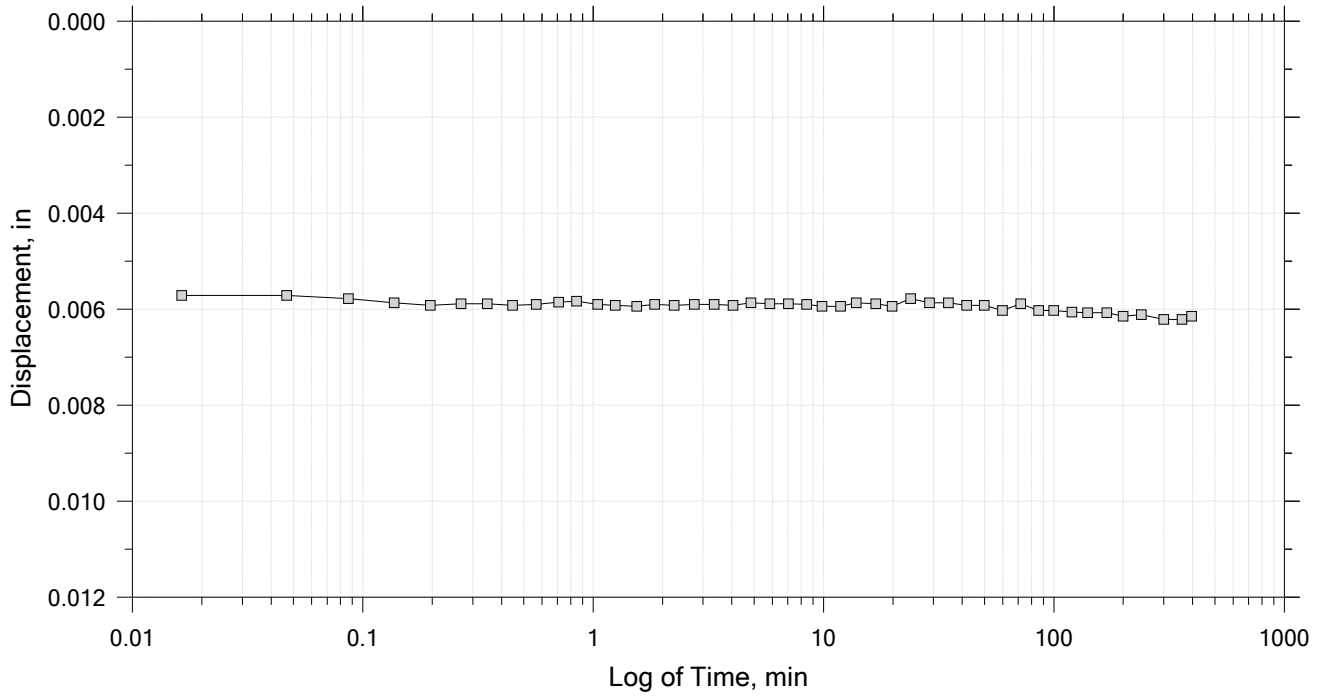
Time Curve 1 of 13
 Constant Load Step
 Stress: 0.01 tsf



Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		

Consolidation Test

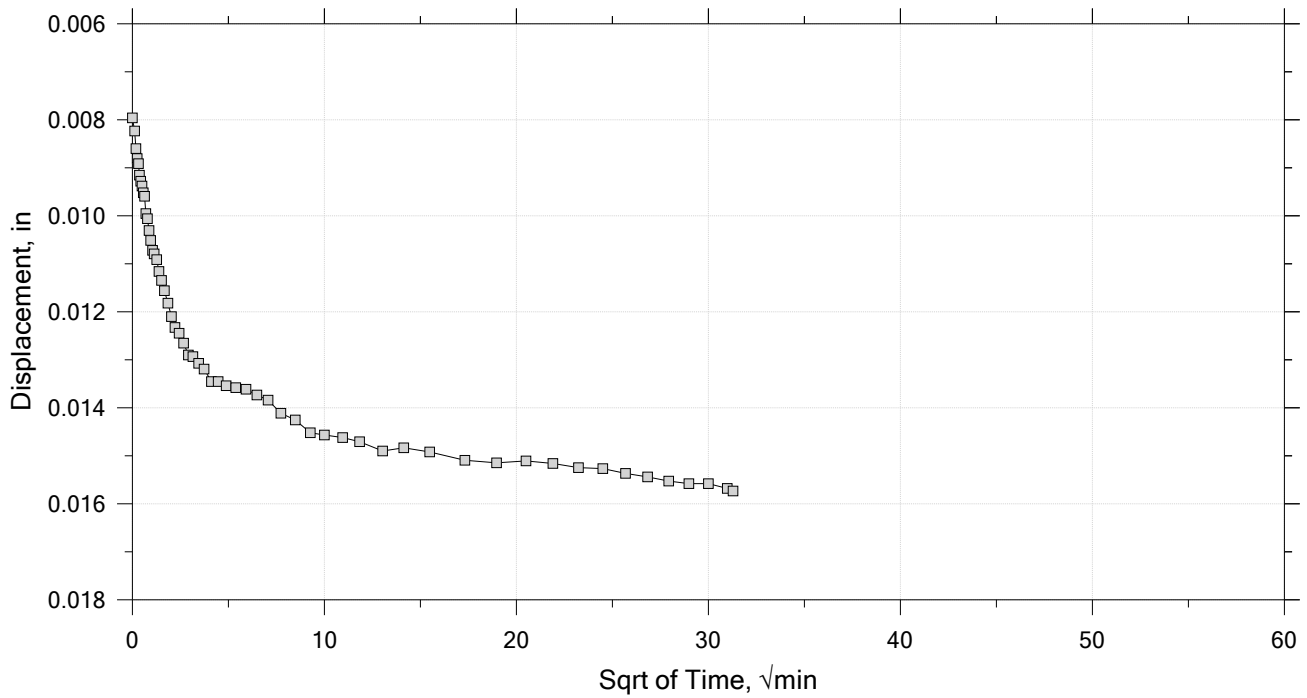
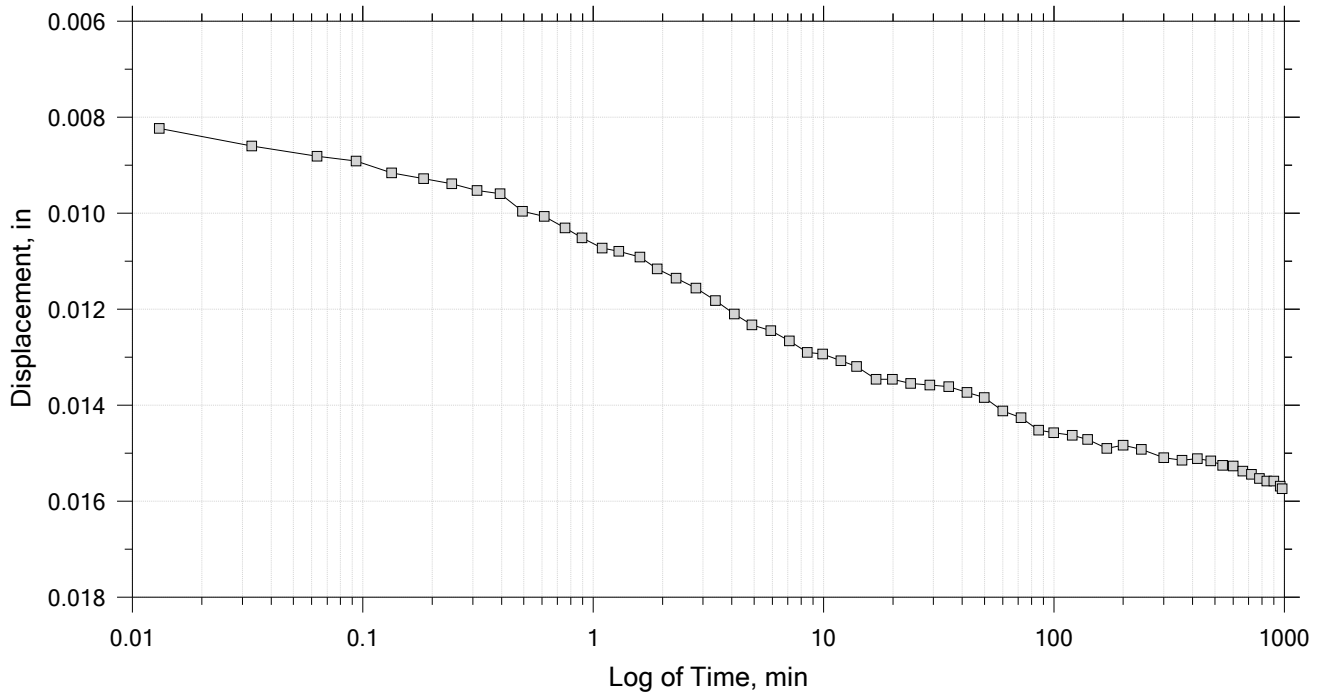
Time Curve 2 of 13
Constant Load Step
Stress: 0.25 tsf



	Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
	Boring Number: 24-1	Tester: JB	Checker:
	Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Lean Clay w/ Sand CL (A-6(8))		
	Remarks: Load Frame #68 collapse swell		

Consolidation Test

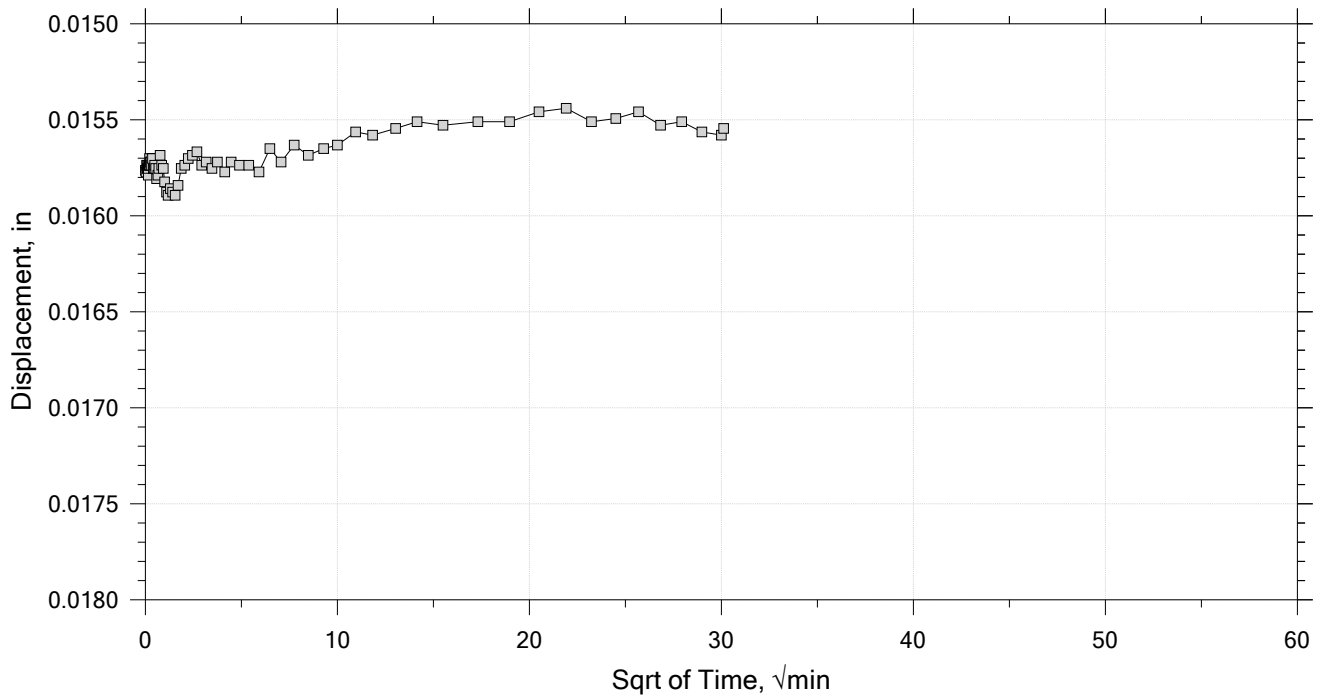
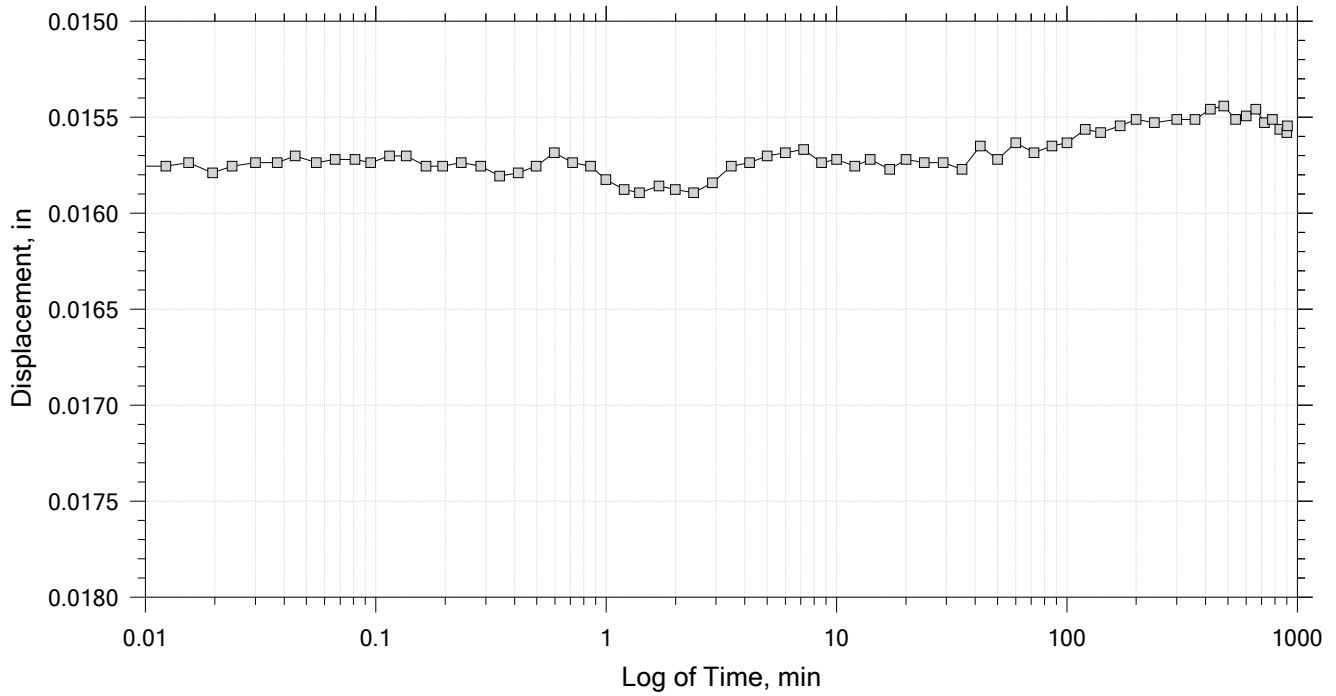
Time Curve 3 of 13
Constant Load Step
Stress: 0.5 tsf



	Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
	Boring Number: 24-1	Tester: JB	Checker:
	Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Lean Clay w/ Sand CL (A-6(8))		
	Remarks: Load Frame #68 collapse swell		

Consolidation Test

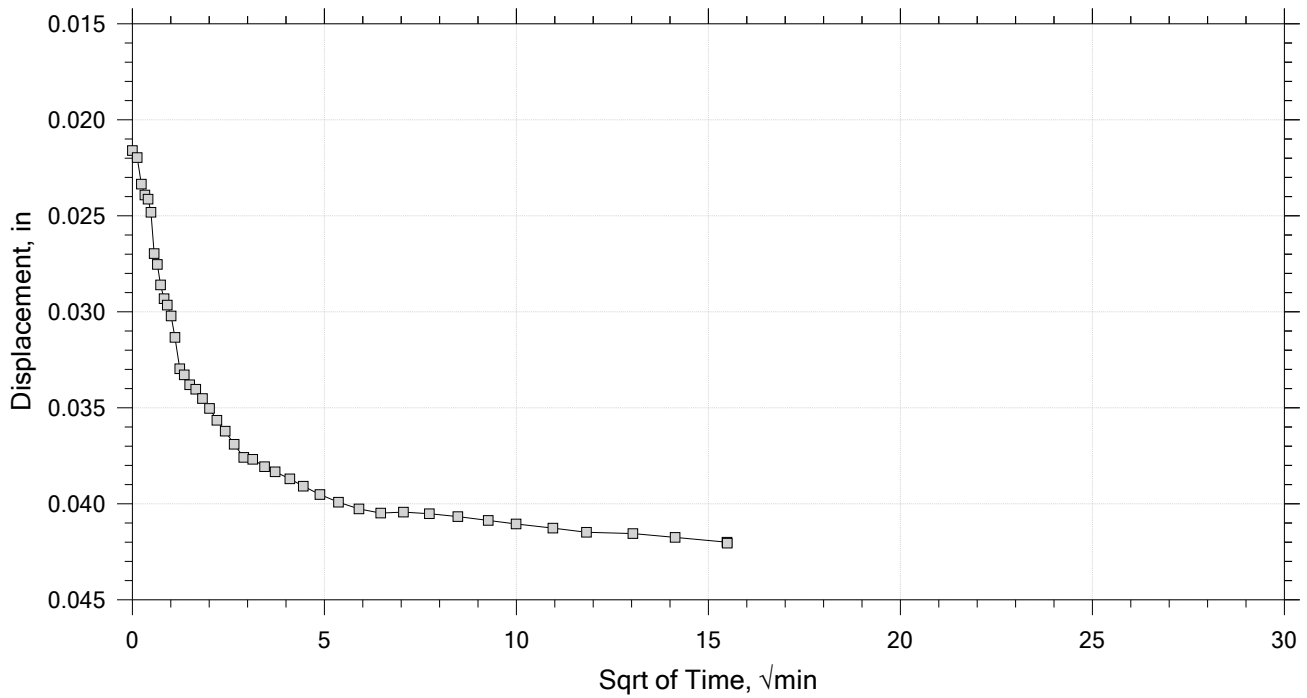
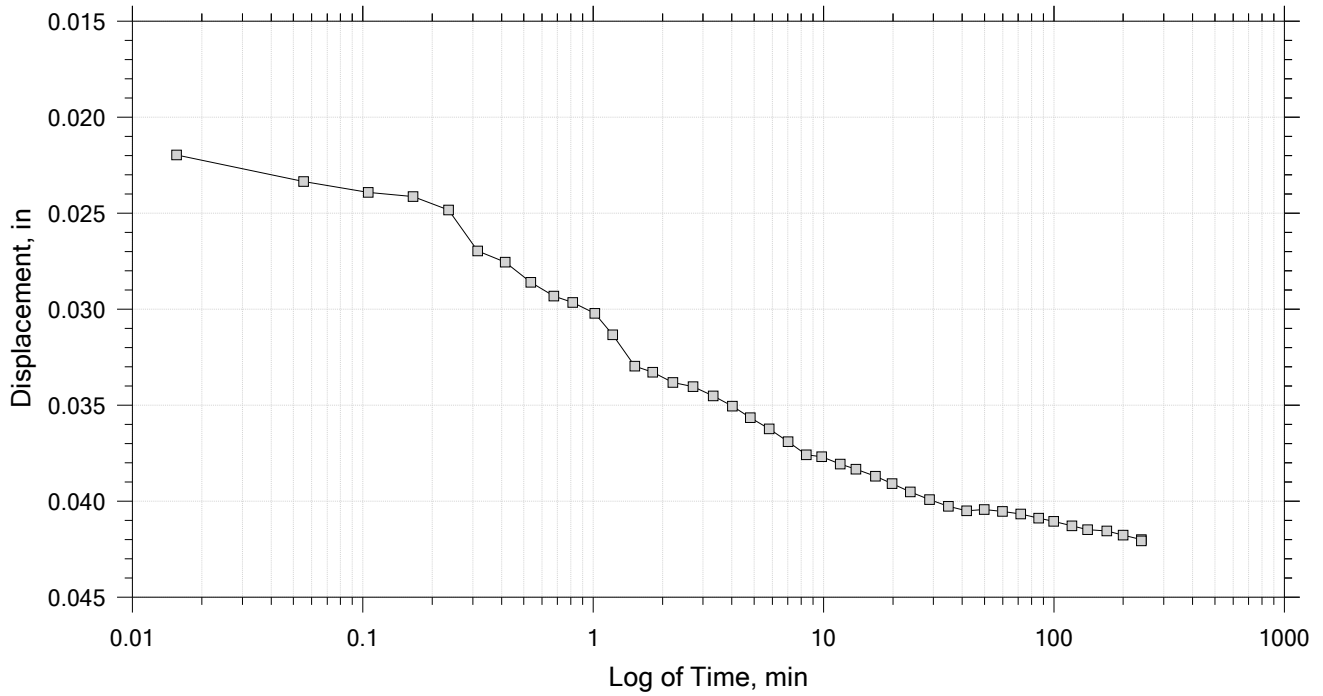
Time Curve 4 of 13
Constant Load Step
Stress: 0.5 tsf



	Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
	Boring Number: 24-1	Tester: JB	Checker:
	Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Lean Clay w/ Sand CL (A-6(8))		
	Remarks: Load Frame #68 collapse swell		

Consolidation Test

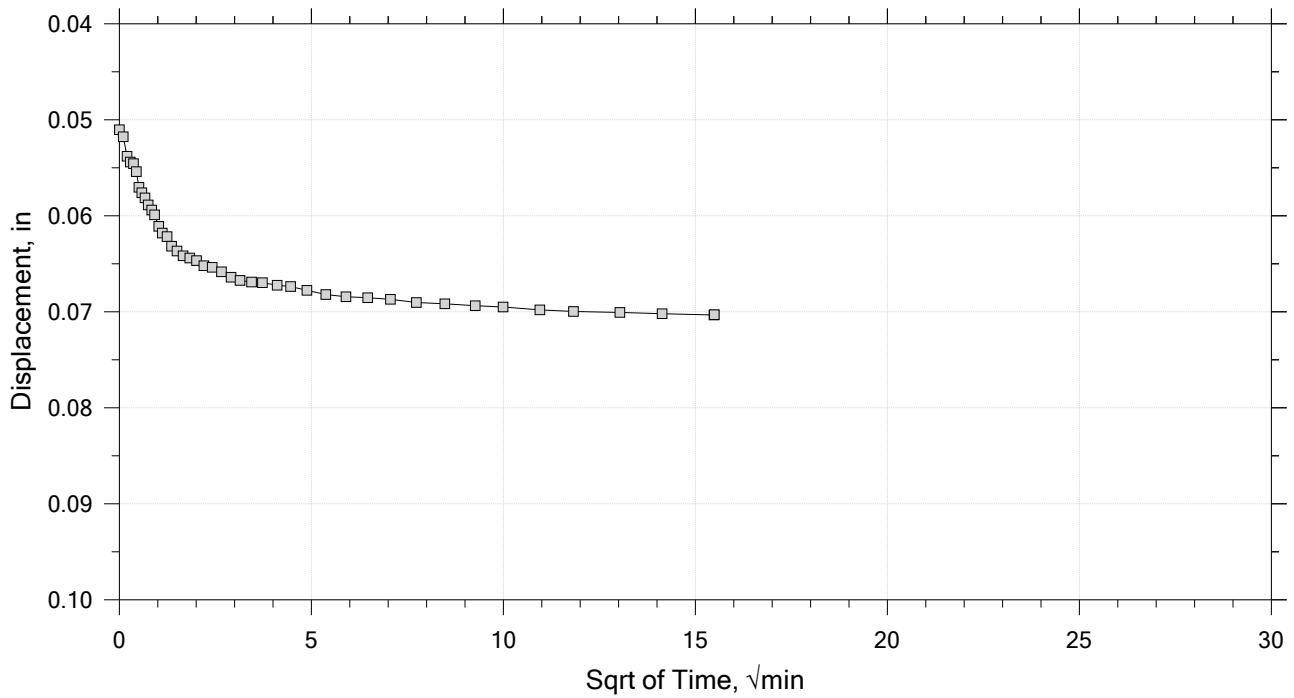
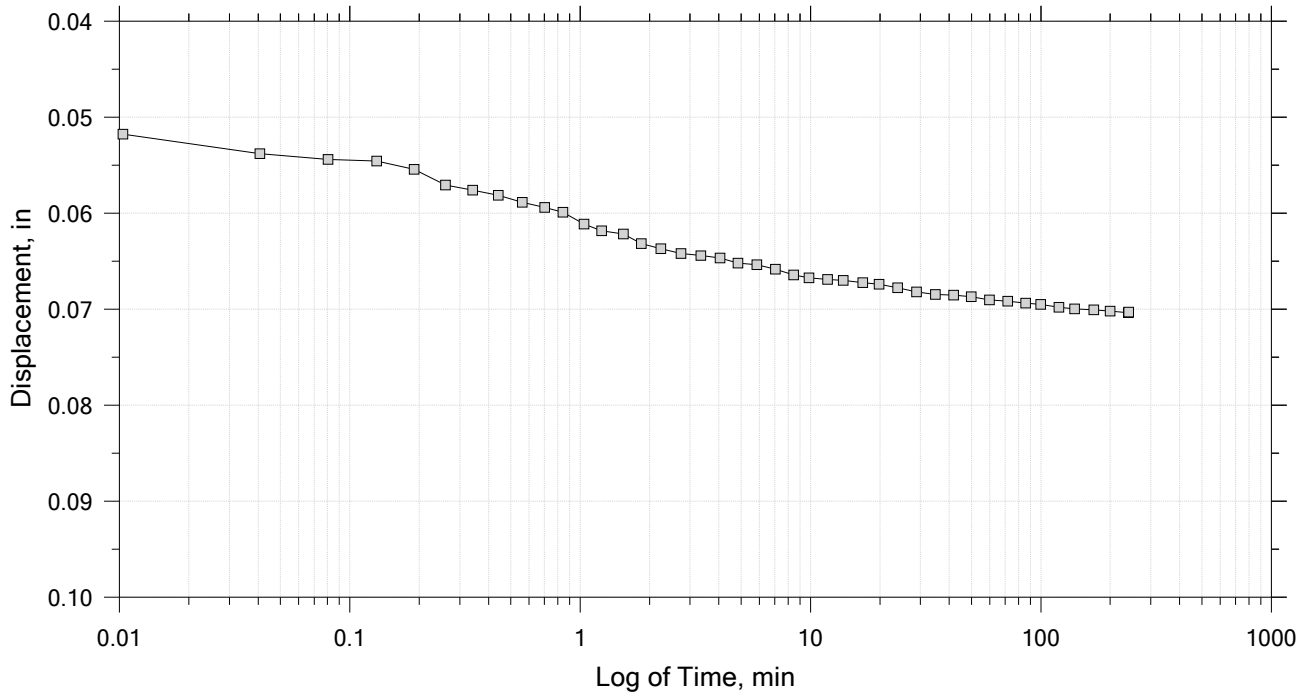
Time Curve 5 of 13
Constant Load Step
Stress: 1 tsf



	Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
	Boring Number: 24-1	Tester: JB	Checker:
	Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Lean Clay w/ Sand CL (A-6(8))		
	Remarks: Load Frame #68 collapse swell		

Consolidation Test

Time Curve 6 of 13
 Constant Load Step
 Stress: 2 tsf



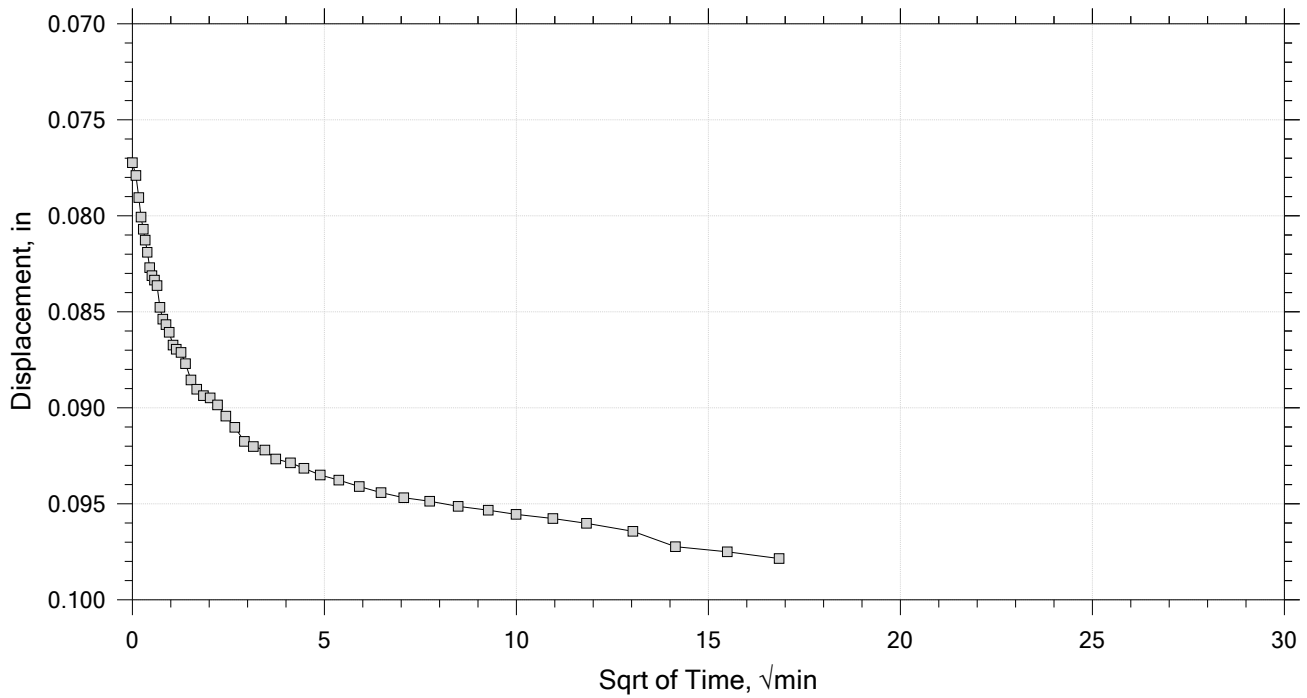
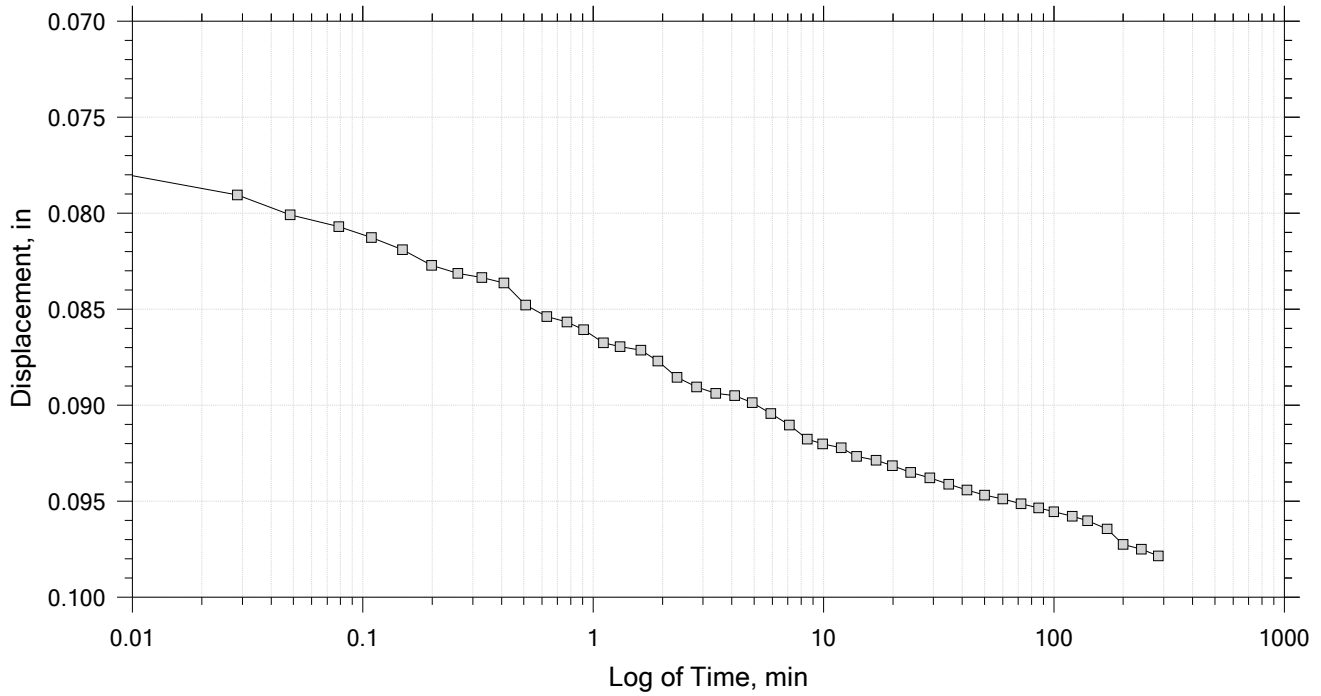
Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		

Consolidation Test

Time Curve 7 of 13

Constant Load Step

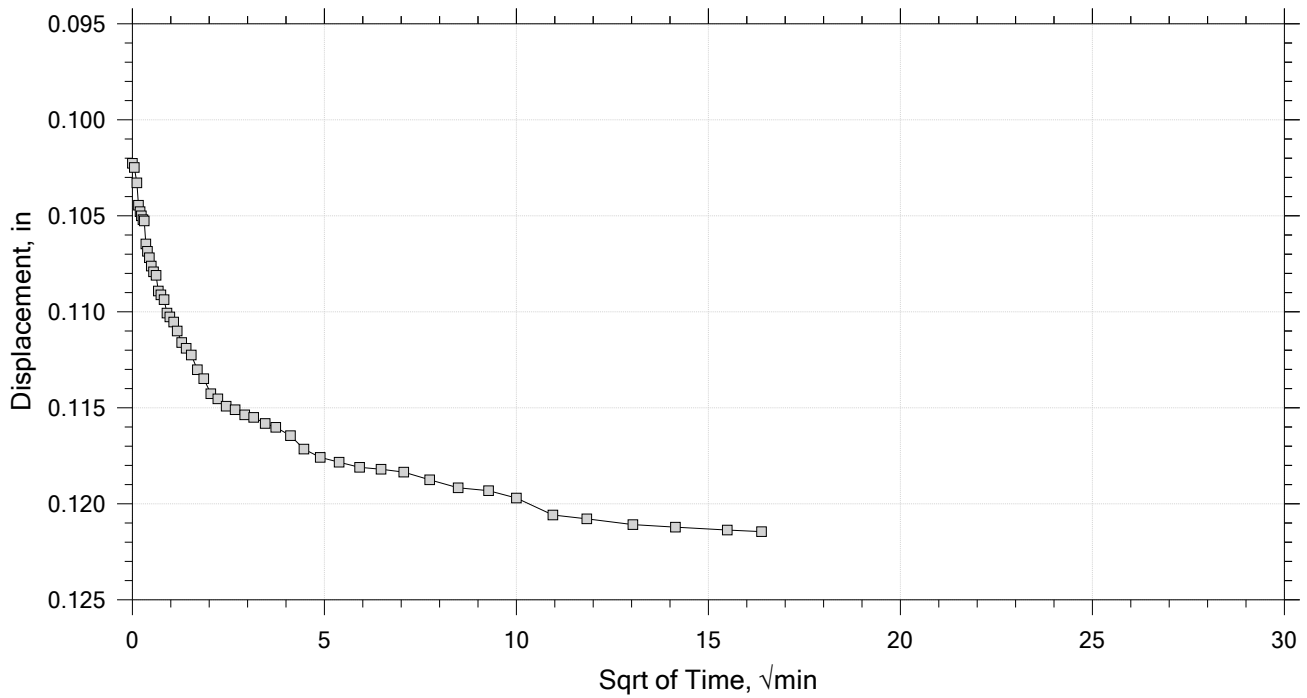
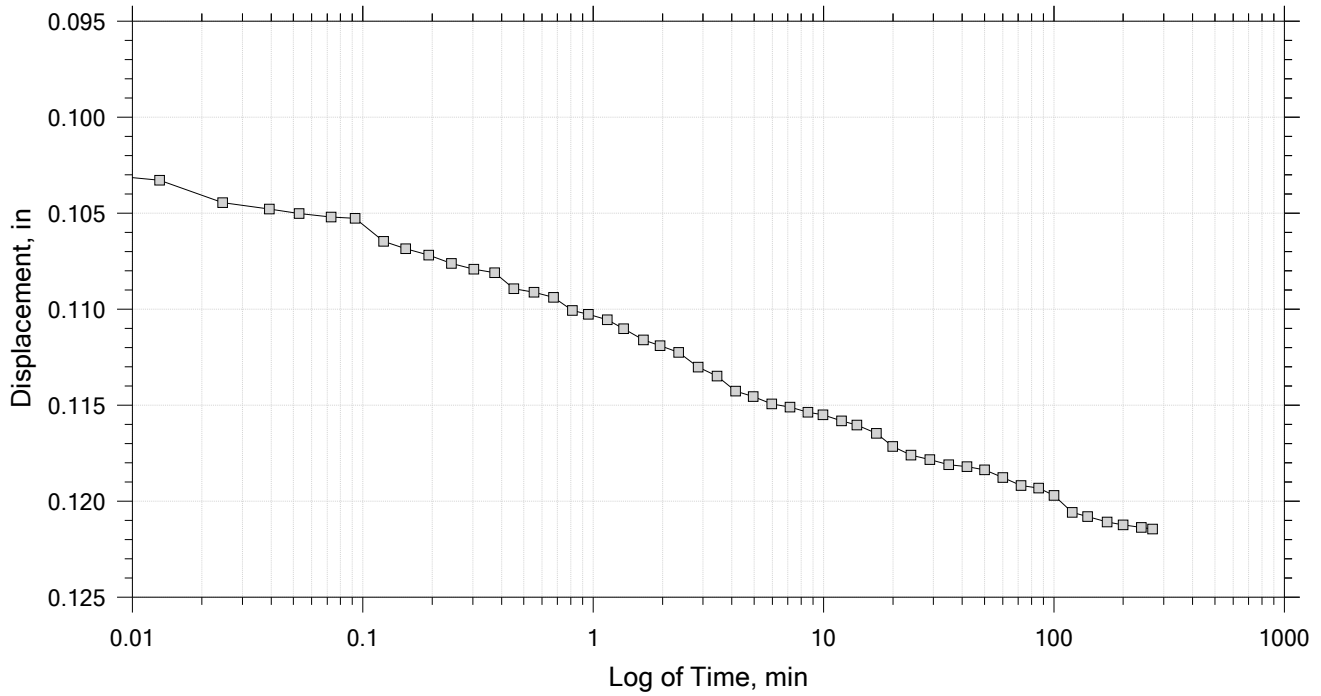
Stress: 4 tsf



Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		

Consolidation Test

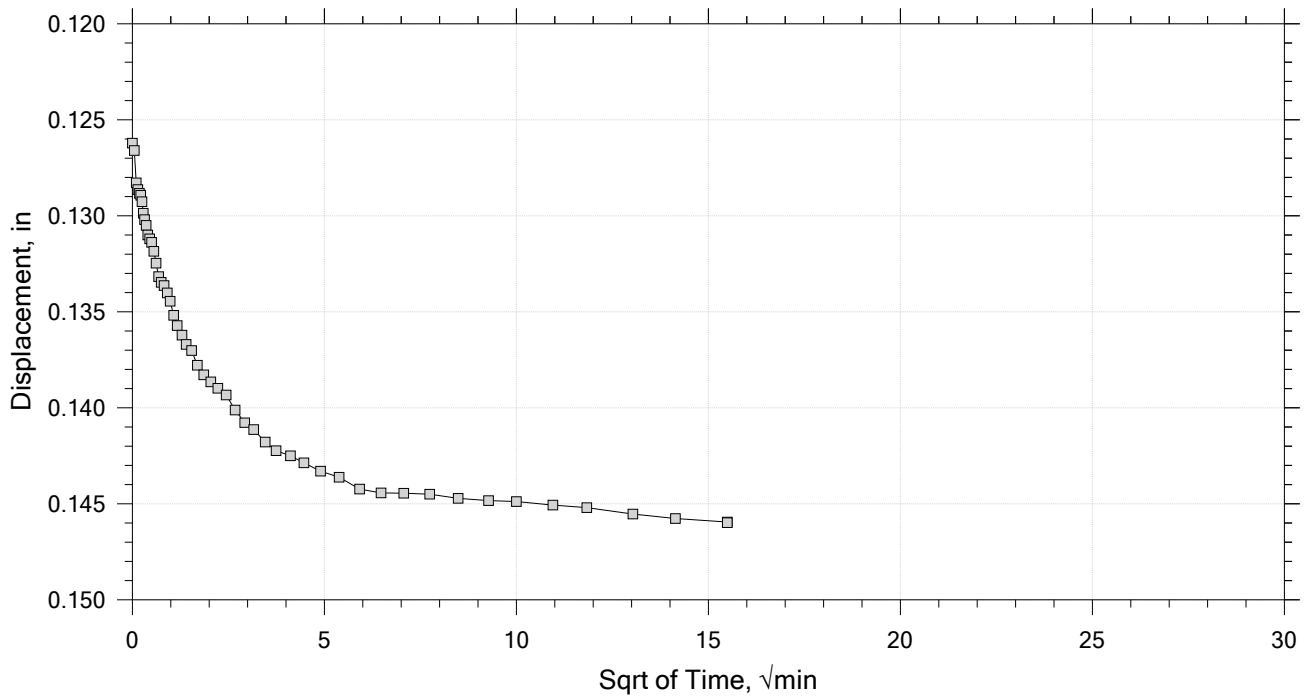
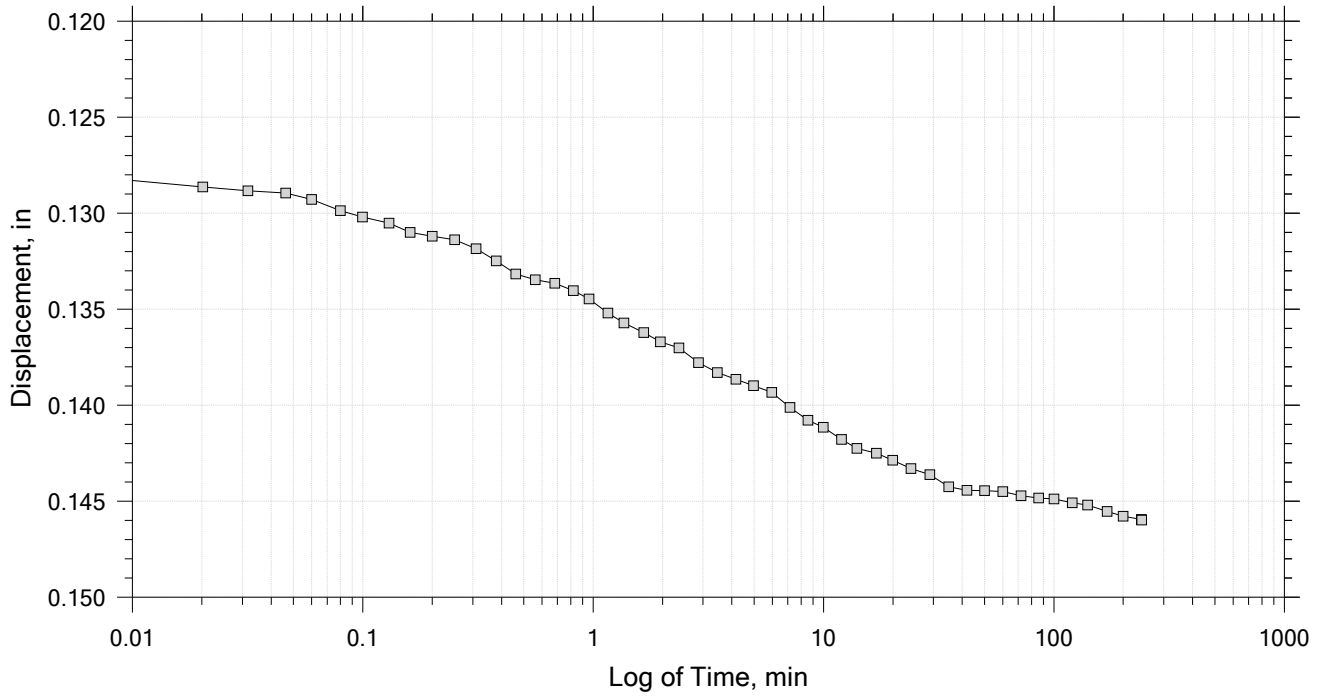
Time Curve 8 of 13
Constant Load Step
Stress: 8 tsf



	Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
	Boring Number: 24-1	Tester: JB	Checker:
	Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Lean Clay w/ Sand CL (A-6(8))		
	Remarks: Load Frame #68 collapse swell		

Consolidation Test

Time Curve 9 of 13
Constant Load Step
Stress: 16 tsf



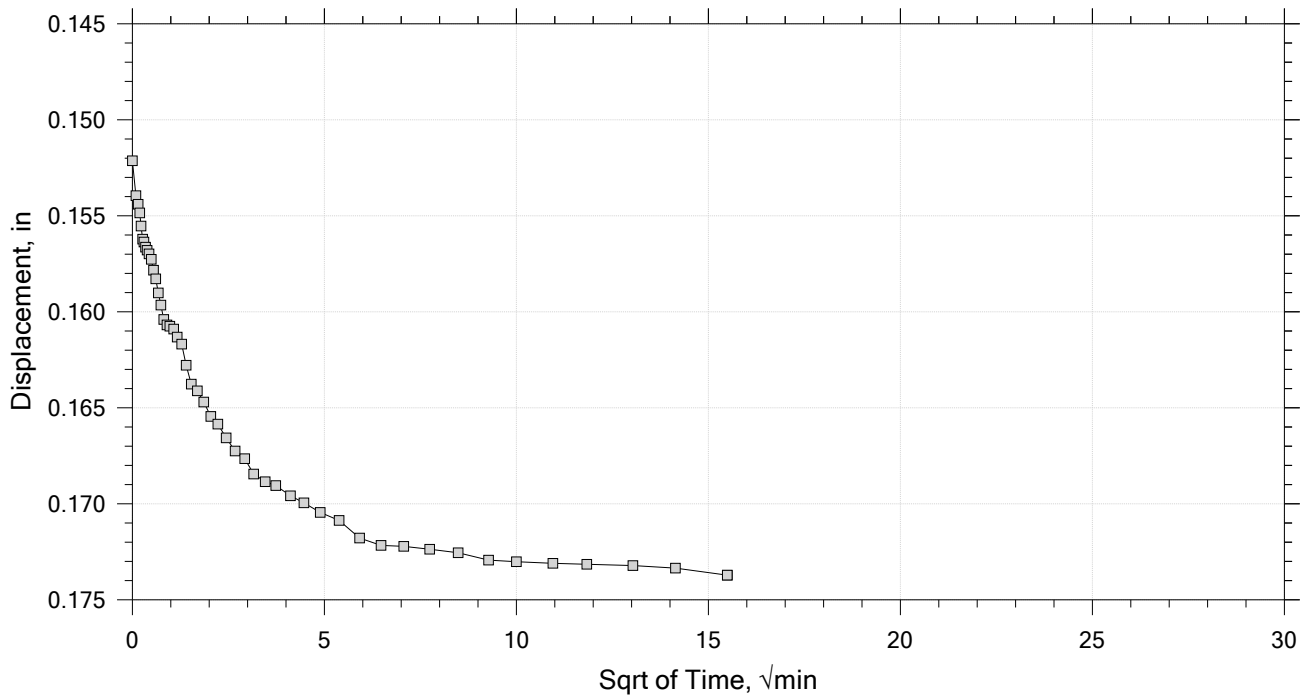
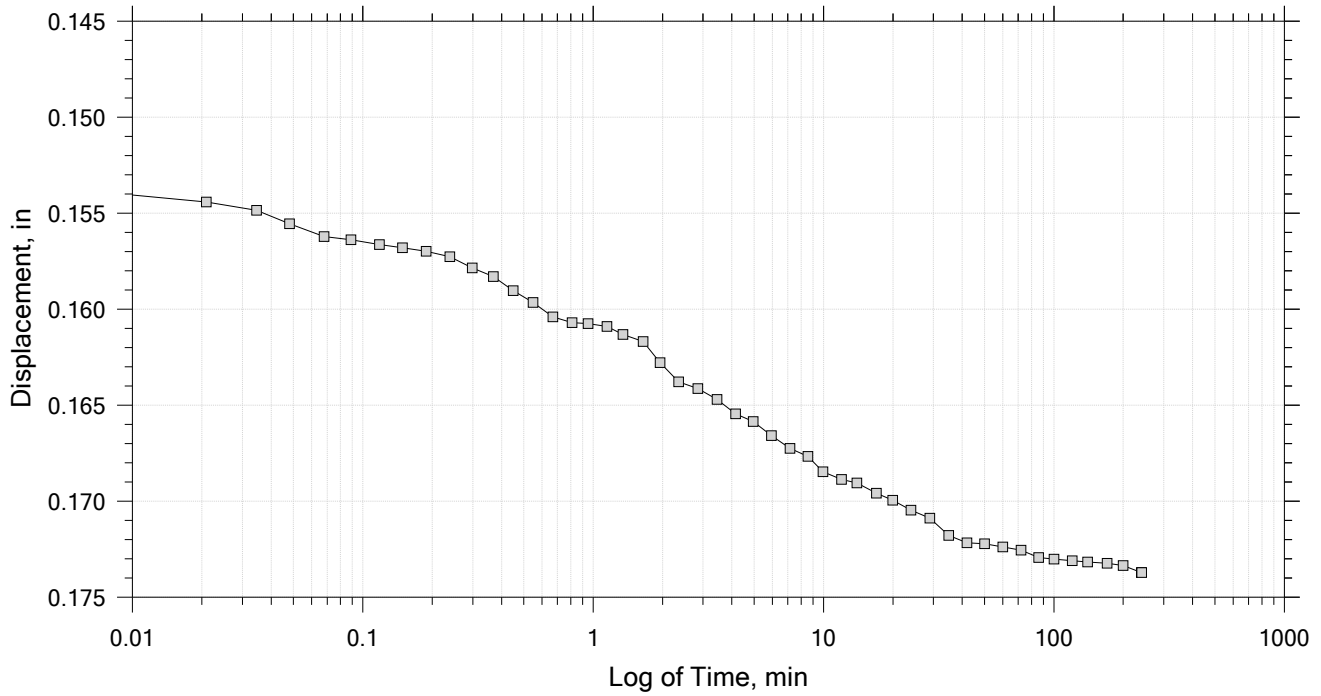
Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		

Consolidation Test

Time Curve 10 of 13

Constant Load Step

Stress: 32 tsf



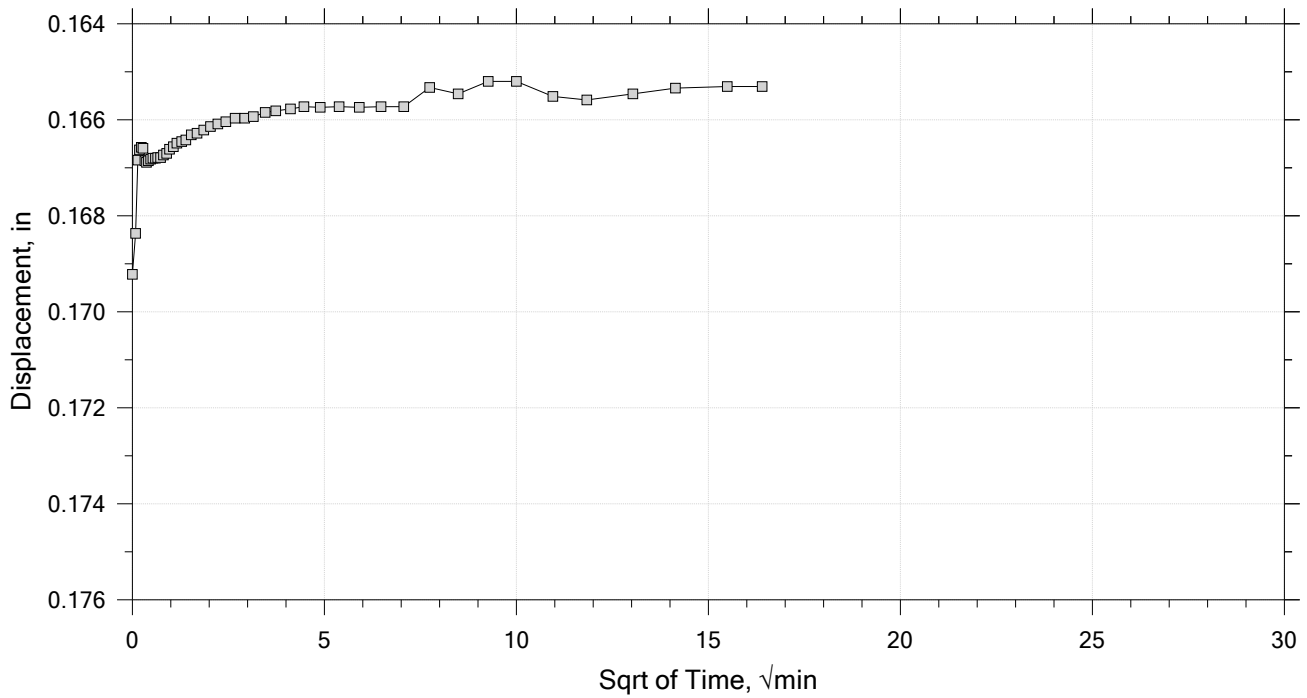
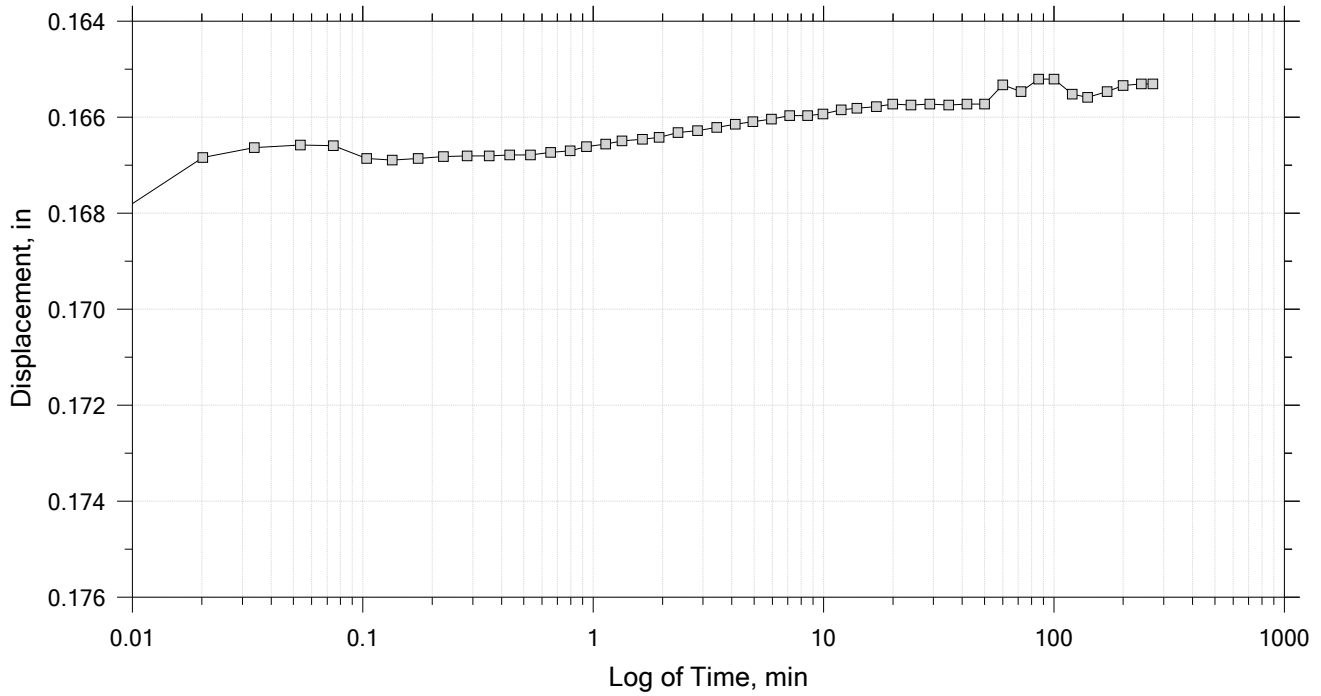
Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		

Consolidation Test

Time Curve 11 of 13

Constant Load Step

Stress: 8 tsf



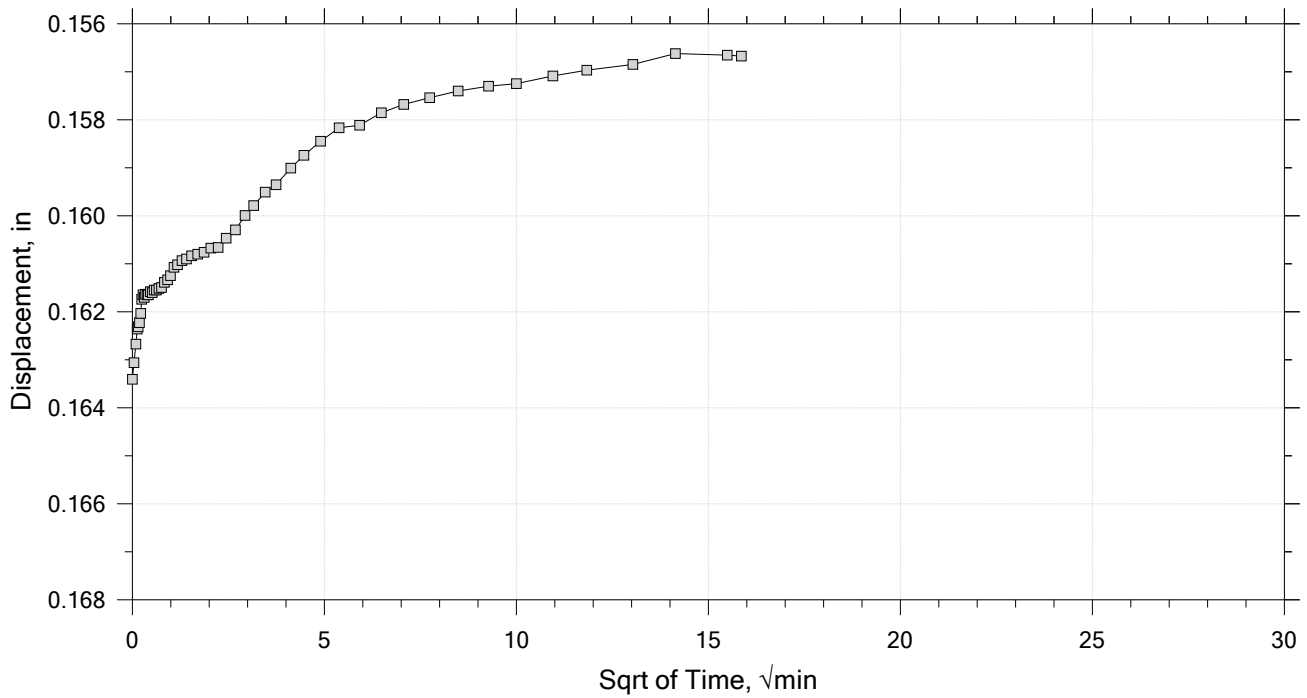
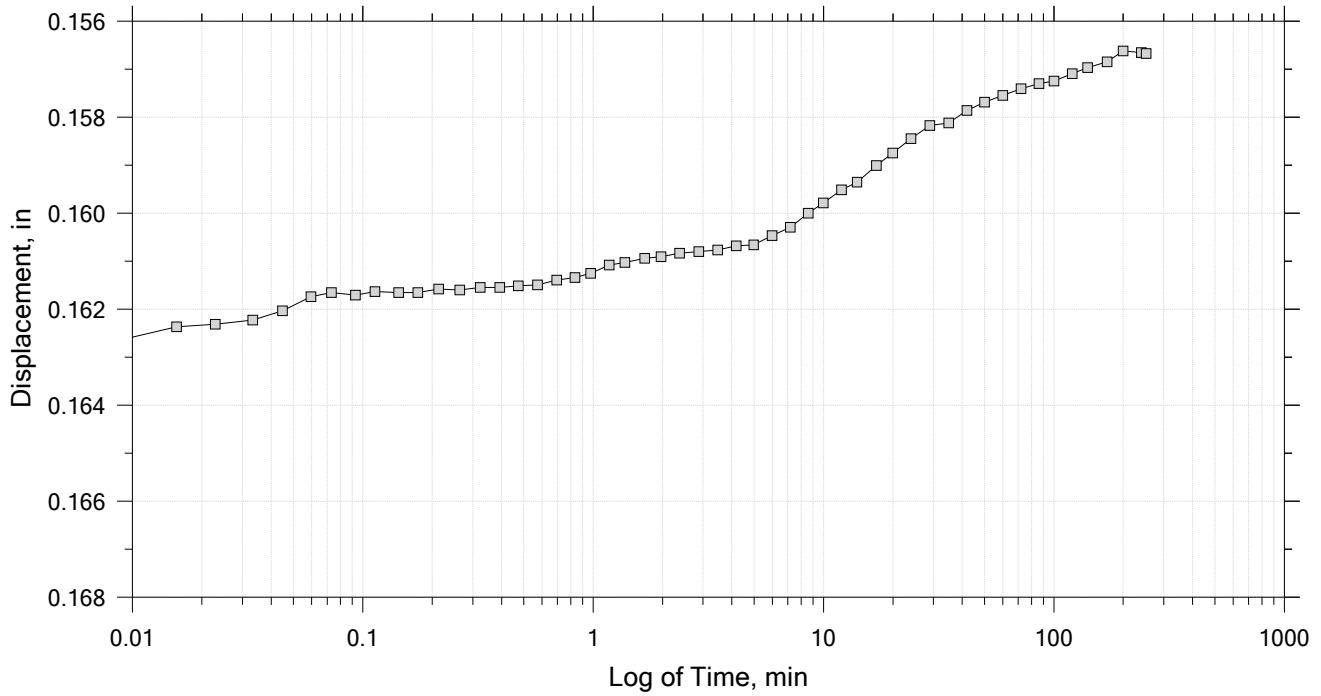
Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		

Consolidation Test

Time Curve 12 of 13

Constant Load Step

Stress: 2 tsf



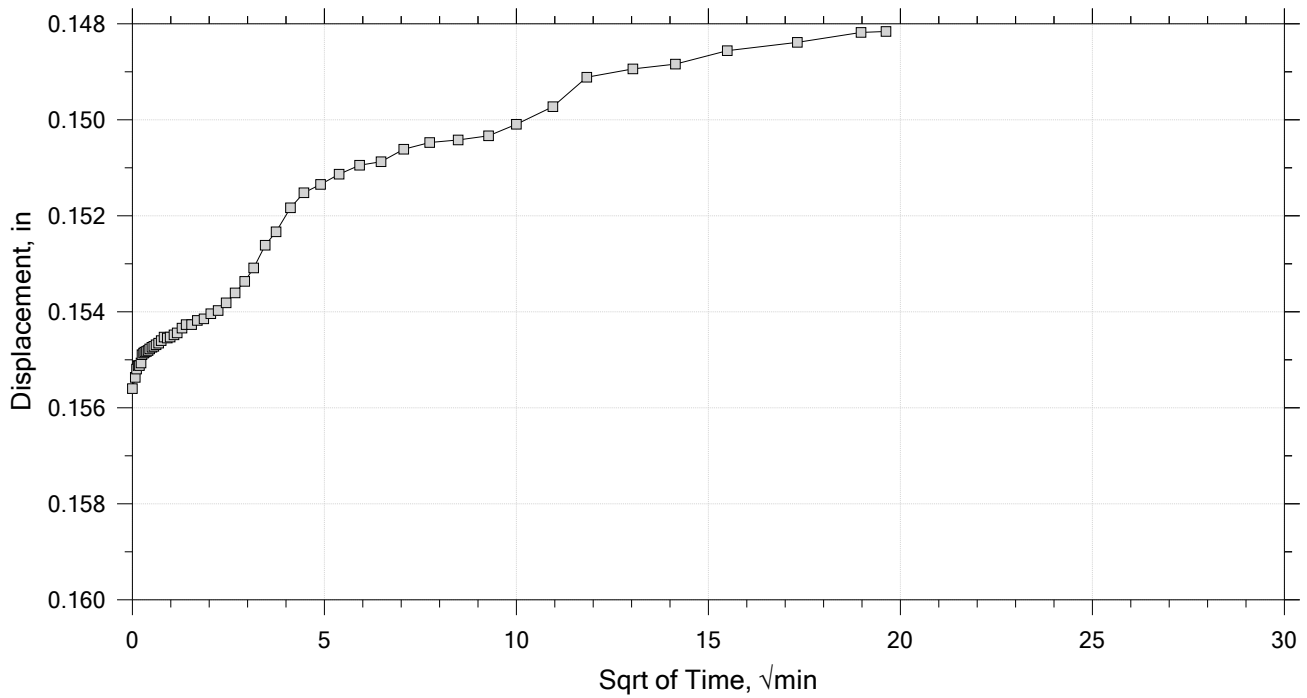
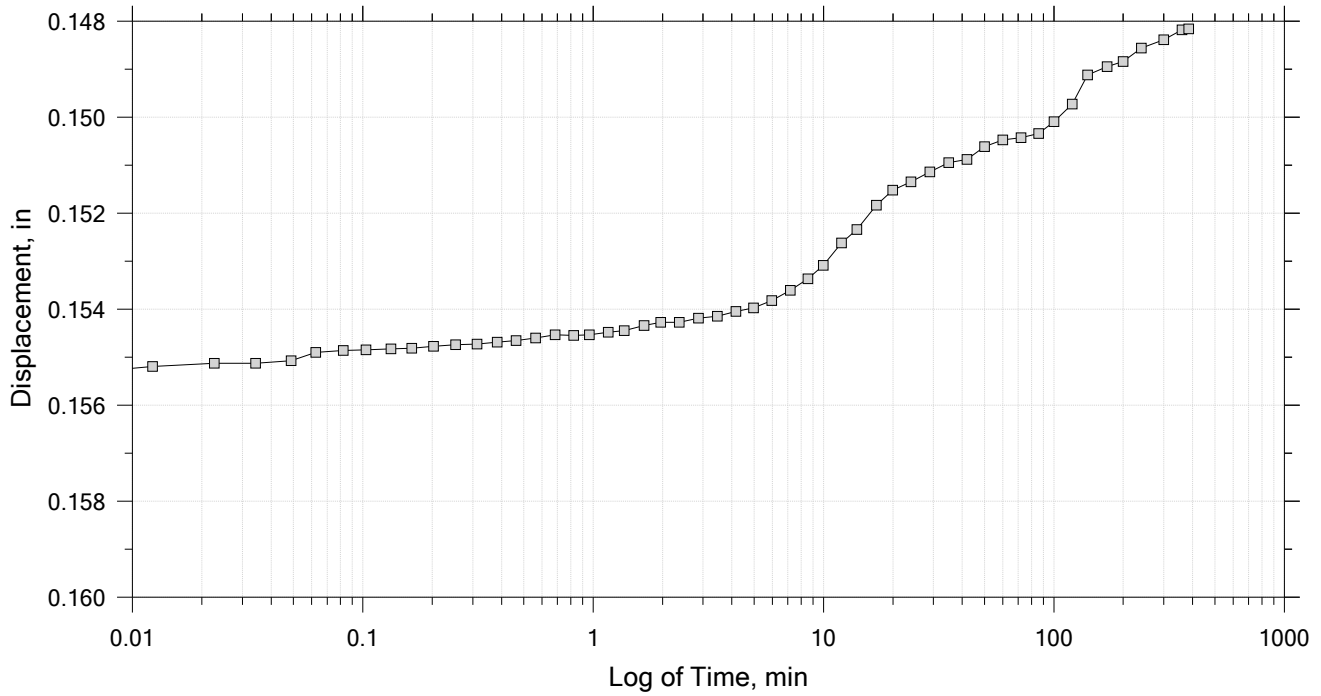
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	Boring Number: 24-1	Tester: JB	Checker:
	Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
	Test Number: 1	Preparation: Shelby Tube	Elevation:
	Client:	Classification:	Group Symbol:
	Description: Lean Clay w/ Sand CL (A-6(8))		
	Remarks: Load Frame #68 collapse swell		

Consolidation Test

Time Curve 13 of 13

Constant Load Step

Stress: 0.5 tsf



Project Name: MT. Pleasant Sewer Lagoon	Location: see site plan	Project Number: 202401-043
Boring Number: 24-1	Tester: JB	Checker:
Sample Number: 1	Test Date: 11-25-2024	Depth: 3-4.5'
Test Number: 1	Preparation: Shelby Tube	Elevation:
Client:	Classification:	Group Symbol:
Description: Lean Clay w/ Sand CL (A-6(8))		
Remarks: Load Frame #68 collapse swell		

MOUNT PLEASANT CITY

LAGOON IMPROVEMENTS

VOLUME II TECHNICAL SPECIFICATIONS (DIVISIONS 01 TO 46)

Bid Set

September 2025

Prepared By:
J-U-B Engineers, Inc.
392 East Winchester Street, Suite 300
Salt Lake City, Utah 84107
Project No. 93-24-009

For:
Mount Pleasant City
115 W Main St
Mt Pleasant, UT 84647


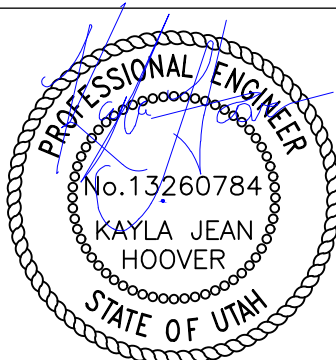


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MT PLEASANT CITY

LAGOON IMPROVEMENTS

TECHNICAL SPECIFICATIONS

RESPONSIBLE PARTIES FOR TECHNICAL SPECIFICATIONS

 <p>09/09/2025</p>	 <p>09/09/2025</p>
 <p>09/09/2025</p>	 <p>09/09/2025</p>

ALL CONSTRUCTION AND MATERIAL SHALL BE IN ACCORDANCE WITH THESE CONTRACT DOCUMENTS. ANY CONSTRUCTION AND MATERIAL NOT EXPLICITLY IDENTIFIED IN THE CONTRACT DOCUMENTS SHALL BE IN ACCORDANCE WITH THE MOST RECENT EDITION PUBLISHED BY THE UTAH CHAPTER OF THE AMERICAN PUBLIC WORKS ASSOCIATION (APWA).

SECTION	RESPONSIBLE ENGINEER	TITLE
<i>DIVISION 01 – GENERAL REQUIREMENTS</i>		
01 11 00	G. Vance	Summary of Work
01 11 80	G. Vance	Environmental Conditions
01 12 16	G. Vance	Work Sequence
01 22 00	G. Vance	Measurement and Payment
01 33 00	G. Vance	Submittal Procedures
01 40 00	G. Vance	Quality Requirements
01 52 00	G. Vance	Construction Facilities
01 60 00	G. Vance	Product Requirements
01 70 00	G. Vance	Execution and Closeout Requirements
01 73 24	G. Vance	Design Requirements for Non-Structural Components and Non-Building Structures
01 75 16	G. Vance	Startup Procedures
01 78 23	G. Vance	Operation and Maintenance Data
01 79 00	G. Vance	Owner Staff Training
<i>DIVISION 03 – CONCRETE</i>		
03 01 00	K. Hoover	Maintenance of Concrete
03 10 00	K. Hoover	Concrete Forms and Accessories
03 20 00	K. Hoover	Concrete Reinforcing
03 30 00	K. Hoover	Cast-In-Place Concrete
03 35 00	K. Hoover	Concrete Finishing
03 39 00	K. Hoover	Concrete Curing
03 60 00	K. Hoover	Grouting
<i>DIVISION 04 – MASONRY</i>		
04 01 00	K. Hoover	Maintenance of Masonry
04 10 00	K. Hoover	Mortar and Grout
04 30 00	K. Hoover	Reinforced Unit Masonry
<i>DIVISION 05 – METALS</i>		
05 04 10	K. Hoover	Hot-Dip Galvanizing
05 12 00	K. Hoover	Structural Steel
05 21 00	K. Hoover	Steel Joist Framing
05 32 00	K. Hoover	Steel Roof Decking
05 50 00	K. Hoover	Metal Fabrications
05 52 50	K. Hoover	Aluminum Handrails & Railings
05 53 00	K. Hoover	Metal Gratings
<i>DIVISION 07 - THERMAL & MOISTURE PROTECTION</i>		
07 19 00	K. Hoover	Water Repellents (Masonry)
07 41 10	K. Hoover	Metal Roof Panels
07 62 10	K. Hoover	Sheet Metal Flashing Trim
07 92 00	K. Hoover	Joint Sealants - Architectural
07 92 13	K. Hoover	Sealants & Caulking

DIVISION 09 - FINISHES

09 96 00	K. Hoover	Protective Coating
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DIVISION 23 – HEATING, VENTILATION, & AIR CONDITIONING

23 05 00	K. Halverson	General HVAC Requirements
23 05 20	K. Halverson	HVAC Identification
23 05 30	K. Halverson	HVAC Operation and Maintenance Manuals
23 05 93	K. Halverson	Testing, Adjusting and Balancing
23 06 03	K. Halverson	Supporting Devices for HVAC
23 06 05	K. Halverson	Mechanical Sound, Vibration and Seismic Control
23 06 07	K. Halverson	Motors, Drives & Electrical Requirements
23 09 00	K. Halverson	HVAC Control Systems
23 23 00	K. Halverson	Refrigeration Piping
23 31 00	K. Halverson	Ductwork
23 31 10	K. Halverson	Ductwork Accessories
23 61 00	K. Halverson	Refrigeration Equipment
23 76 00	K. Halverson	Terminal Electric Heat Transfer Units
23 82 00	K. Halverson	Power Ventilators
23 90 00	K. Halverson	Air Filters

DIVISION 26 – ELECTRICAL

26 05 00	B. Hillyer	Electrical General Requirements
26 05 05	B. Hillyer	Operation and Maintenance Manuals
26 05 07	B. Hillyer	Electrical Power System Studies
26 05 08	B. Hillyer	Electrical Acceptance Tests
26 05 09	B. Hillyer	Electrical Identification
26 05 10	B. Hillyer	Equipment for Hazardous Locations
26 05 19	B. Hillyer	Conductors and Cables
26 05 22	B. Hillyer	Wiring Devices
26 05 24	B. Hillyer	Equipment Wiring
26 05 26	B. Hillyer	Grounding and Bonding
26 05 30	B. Hillyer	Conduits
26 05 34	B. Hillyer	Electrical Boxes and Fittings
26 09 13	B. Hillyer	Control Devices
26 16 00	B. Hillyer	Panels and Consoles
26 20 00	B. Hillyer	Service and Distribution Systems
26 22 00	B. Hillyer	Dry Type Transformers
26 24 16	B. Hillyer	Branch Circuit Panelboards
26 24 21	B. Hillyer	Motor Starters
26 26 00	B. Hillyer	Terminal Blocks
26 28 13	B. Hillyer	Fuses
26 28 19	B. Hillyer	Disconnect Switches
26 35 53	B. Hillyer	Surge Protection Devices
26 41 00	B. Hillyer	Lightning Protection Systems
26 51 13	B. Hillyer	Interior Luminaries

DIVISION 31 – EARTHWORK

31 05 16	G. Vance	Aggregate Materials
31 05 19.13	G. Vance	Geotextile Liner
31 05 19.16	G. Vance	Geomembrane Liner
31 10 00	G. Vance	Site Clearing
31 11 20	G. Vance	Soil Materials
31 11 23	G. Vance	Aggregate Base Coarse
31 22 13	G. Vance	Rough Grading
31 23 16	G. Vance	Excavation
31 23 23	G. Vance	Backfilling for Structures
31 23 33	G. Vance	Excavation and Backfill for Pipes and Utilities
<i>DIVISION 33 – UTILITIES</i>		
33 05 60	G. Vance	Precast Concrete Utility Structures
33 30 00	G. Vance	Sewer Bypass Pumping
<i>DIVISION 40 – PROCESS INTERCONNECTIONS</i>		
40 05 10	G. Vance	Pipe and Fittings
40 05 11	G. Vance	Pipe Supports
40 05 59	G. Vance	Stainless Steel Slide Gates and Weir Gates
40 10 00	B. Hillyer	Process Control & Instrumentation System-General
40 15 10	B. Hillyer	Process Control Strategies
40 20 00	B. Hillyer	Instruments General
40 71 00	B. Hillyer	Control Systems - Panels, Enclosures and Components
40 91 21	B. Hillyer	Temperature Transmitter
<i>DIVISION 46 – WATER AND WASTEWATER EQUIPMENT</i>		
46 21 00	G. Vance	Screening Equipment

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**SECTION 01 11 00
SUMMARY OF WORK**

PART 1. GENERAL

1.1 SUMMARY

- A. The Work to be performed under this Contract involves improvements to lagoon cell 3 and the construction of a new headworks building, including installation of automatic screen, HVAC and plumbing, electrical, instrumentation, site work, yard piping, septage receiving station, and all other equipment and infrastructure needed to make the new facilities complete and operational.
- B. The project includes all labor, mobilization, equipment, materials, installation, startup and commissioning, and all related appurtenances as shown on the drawings and described in the specifications.

1.2 RELATED SECTIONS

- A. Section 01 12 16 - Work Sequence
- B. Section 01 40 00 - Quality Requirements

1.3 PROJECT SUMMARY

1.4 WORK BY OWNER

- A. Normal day-to-day operations of the existing lagoons will be ongoing. Construction shall not isolate or interrupt existing wastewater conveyance and treatment activities, including, but not limited to, Owner's staff operation, maintenance, and repair except as specifically described herein.
- B. Whenever existing systems and equipment are scheduled to be taken out of service, the Owner will operate all valves and equipment to shut off and isolate the system from plant flow stream.
- C. Mt Pleasant City intends to self perform the subgrade preparation, however, the contractor will complete any remaining items required by the liner installer.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Construct work in an orderly and timely manner to minimize vehicular traffic and operations personnel disruption.
- B. During construction period, coordinate construction schedule and operations with Owner and Engineer.

-
- C. Water for project work, including testing, dust control, etc. may be obtained from an existing Mt Pleasant City fire hydrant. Owner will provide a reasonable amount of water at no cost to the Contractor. Contractor shall provide a backflow prevention device and meter the water.
 - D. Perform work in coordination with operations scheduled work times, Monday through Sunday 7:00 am to 5:00 pm. After hours work shall be coordinated with Owner prior to work.
 - a. Access to facility by gate, facilities to remain locked by key pad while not occupied.

1.6 OWNER OCCUPANCY

- A. Owner will occupy the premises during the entire period of construction for normal operation of the lagoons. Cooperate with Owner in all startups, testing, and demonstration period operation to minimize conflict and to facilitate Owner usage.
- B. Owner's personnel will be responsible for operating the existing lagoons throughout the execution of this Contract. Equipment presently installed must at the site shall be available to Owner's personnel at all times for use, maintenance, and repairs.

1.7 WORK BY OTHER CONTRACTORS

- A. Additional work by other Contractors may be performed at the Lagoon site under separate contract and will require coordination and scheduling by Contractor with those separate efforts, at no additional cost.
- B. Contractor shall coordinate with other contractors on site as noted above (or as required during the course of this project) during all work phases, including, but not limited to, shutdowns, equipment installation, startups, testing, and demonstration period operation to minimize conflicts and to facilitate usage of Lagoon systems by Owner.

1.8 ABBREVIATIONS

- A. Wherever the following abbreviations are used, they shall have the meanings indicated:
 - 1. AASHTO - American Association of the State Highway and Transportation Officials
 - 2. ACI - American Concrete Institute
 - 3. AGA - American Gas Association
 - 4. AGMA - American Gear Manufacturers' Association
 - 5. AI - The Asphalt Institute
 - 6. AIA - American Institute of Architects
 - 7. AISC - American Institute of Steel Construction
 - 8. AISI - American Iron & Steel Institute

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9. AITC - American Institute of Timber Construction
 10. ANSI - American National Standards Institute
 11. APA - American Plywood Association
 12. API - American Petroleum Institute
 13. APWA - American Public Works Association
 14. AREA - American Railway Engineering Association
 15. ASCE - American Society of Civil Engineers
 16. ASHRAE - American Society of Heating, Refrigerating, and Air Conditioning Engineers
 17. ASME - American Society of Mechanical Engineers
 18. ASQC - American Society for Quality Control
 19. ASTM - American Society for Testing and Materials
 20. AWWA - American Water Works Association
 21. AWPI - American Wood Preservers Institute
 22. AWS - American Welding Society
 23. AWWA - American Water Works Association
 24. CBM - Certified Ballast Manufacturers
 25. CLFMI - Chain Link Fence Manufacturers Institute
 26. CRSI - Concrete Reinforcing Steel Institute
 27. DIPRA - Ductile Iron Pipe Research Association
 28. ETL - Electrical Test Laboratories
 29. FHWA - Federal Highway Administration
 30. IBC - International Building Code
 31. ICEA - Insulated Cable Engineers Association
 32. UDEQ - Utah Department of Environmental Quality
 33. IEEE - Institute of Electrical and Electronics Engineers

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34. IPCEA - Insulated Power Cable Engineers Association
 35. ISA - Instrument Society of America
 36. ISO - Insurance Services Office
 37. ITE - Institute of Transportation Engineers
 38. MUTCD - Manual on Uniform Traffic Control Devices
 39. NEC - National Electrical Code
 40. NEMA - National Electrical Manufacturers Association
 41. NEPA - National Environmental Policy Act
 42. NFPA - National Fire Protection Association
 43. NFPA - National Forest Products Association
 44. OSHA - Occupational Safety and Health Act of 1970
 45. PCA - Portland Cement Association
 46. SAE - Society of Automotive Engineers
 47. SEPA - State Environmental Policy Act
 48. SSPC - Steel Structures Painting Council
 49. UBC - Uniform Building Code, International Conference of Building Official
 50. UL - Underwriters' Laboratories, Inc.
 51. UPC - Uniform Plumbing Code
 52. WAC - Washington Administrative Code
 53. WCLIB - West Coast Lumber Inspection Bureau
 54. WCRSI - Western Concrete Reinforcing Steel Institute
 55. WRI - Wire Reinforcement Institute
 56. WRF - Water Reclamation Facility
 57. WWPA - Western Wood Products Association
 58. WWTF - Wastewater Treatment Facility

59. WWTP - Wastewater Treatment Plant

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

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**SECTION 01 11 80
ENVIRONMENTAL CONDITIONS**

PART 1. GENERAL

1.1 ENVIRONMENTAL CONDITIONS

A. This section describes the environmental conditions which have been observed at the site of the work and which may reasonably be anticipated throughout the life of the project.

1.2 CLIMATE CONDITIONS

A. The site of the work is at an elevation of approximately 5,900 feet above mean sea level.

B. Climate conditions are described as follows:

	Range of Conditions
Winter Outdoor Low Temperature	0°F to 30°F
Summer Outdoor High Temperature	75°F to 105°F
Indoor Temperature Range	50°F to 90°F

1.3 ADDITIONAL CONDITIONS

A. Electrical Classification

1. Refer to the electrical drawings for National Fire Protection Agency (NFPA) 820 electrical classifications.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

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SECTION 01 12 16 WORK SEQUENCE

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Existing Conditions
2. Major Work Elements
3. Submittals
4. Work Sequence

B. Related Sections:

1. Section 01 22 00 Measurement and Payment
2. Section 01 23 00 Schedule of Values

1.2 EXISTING LAGOON INFRASTRUCTURE

A. The headworks facility receives raw sewage from the collection system before it enters the lagoons. The existing headworks facility has no building to protect the channel, no screening equipment, and has failing chemical dosing pumps. These issues have resulted in reduced performance while increasing O&M requirements. The existing headworks is made up with a series of unit processes:

1. Influent Flow Measurement
2. Dosing pump

B. The Total Containment Lagoons receive influent from the headworks facility. The lagoon consists of a total of 4 cells, with 2 currently in use. Cells 3 and 4 have remained empty and dry, resulting in cracking of the clay liner. Increasing wastewater flows not require the use of cell 3, which has a liner unsuitable to contain sewage.

1.3 OPERATING PERMIT CONDITIONS

A. The lagoons are a total containment system and must meet:

1. The Owner's Operating Permit (#UTOP00128). Compliance with the operating Permit shall be maintained at all times during construction. A copy of the permit may be obtained at: <https://deq.utah.gov/water-quality/wastewater-treatment-facilities-operating-permits>

- B. Owner will notify Contractor immediately if permit is violated.
- C. If Contractor's actions result in a violation of the Operating Permit or an imminent violation as determined by Owner and/or Engineer, Contractor shall mitigate any damages, suspend certain aspects of work if deemed necessary by Owner and Engineer, and fully cooperate with Owner and Engineer to bring facility into compliance with Operating Permit at no cost to Owner.
- D. Penalties and any and all related costs, including but not limited to legal and engineering expenses, imposed on or incurred by Owner as a result of any bypass or operating permit violation caused by the actions or inactions of the Contractor, its employees, subcontractors or agents, are to be borne in full by the Contractor.
- E. Bypassing untreated or partially treated wastewater to surface waters is prohibited.

1.4 MAJOR WORK ELEMENTS

- A. The new headworks building will include the following processes:
 - 1. Influent Screen
 - a. An automatic mechanical influent screen will be installed in the existing channel.
 - b. Contractor shall maintain sewer flow entering the lagoons during construction. The incoming flow would need to bypass the existing channel during screen installation.
 - 2. Influent flow measurement
 - a. Existing flume and related instrumentations, used for flow measurement, shall be protected during construction.
 - 3. Biolyneceus dosing system
 - a. The existing dosing pump will be replaced. The biolyneceus drums and the new pump shall be moved to a new location inside, as shown in the plans.
 - i. Long term outage of the biolyneceus dosing system for up to 6 months is allowed during construction of the new headworks building.
- B. Septage receiving station will include the following:
 - 1. Concrete dump pad and septage storage tank per plans.
 - 2. Connection to main influent line shall not interrupt flows to the influent channel. Design includes the use of a doghouse manhole to install the connection with

minimal impacts. Bypass pumping is not anticipated, the contractor is responsible for any needed bypass pumping at no cost to the owner.

C. Lagoon Cell 3 improvements will include the following:

1. Modifications to inlet and outlet structures for HDPE liner integration.
2. Installation of a 60 mil thickness HDPE Geomembrane Liner. This includes subgrade preparation to be done by owner, any deficiencies will be addressed by the contractor. Contractor shall coordinate with owner the date subgrade preparation is finished by owner.
3. Contractor shall coordinate with owner to keep cell 3 empty for the duration of the modifications.

1.5 SUBMITTALS

- A. Provide detailed outage and time schedule plan for each work item that may impact plant operation. Provide long-range and short-range plans, as appropriate for coordinating work with Owner.
- B. Submit in accordance with Section 01 33 00.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

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SECTION 01 22 00 MEASUREMENT AND PAYMENT

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Authority
2. Payment
3. Defect Assessment
4. Non-Payment for Rejected Products
5. General Description of Measurement and Payment
6. Alternates
7. Schedule of Bid Items

B. Related Sections

1. Section 00 41 00 Bid Form
2. Section 00 70 00 General Conditions
3. Section 01 11 00 Summary of Work

1.2 AUTHORITY

- A. See EJCDC C-700 General Conditions 10.07 and 10.08

1.3 PAYMENT

- A. See EJCDC C-700 General Conditions 15.01

1.4 DEFECT ASSESSMENT

- A. EJCDC C-700 General Conditions 10.04 – Rejecting Defective Work

1. See EJCDC C-700 General Conditions and Article 14

- B. The authority of the Engineer to assess the defect and identify payment adjustment is final.

1.5 NON-PAYMENT FOR REJECTED PRODUCTS

-
- A. Payment will not be made 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 the transporting vehicle.
 4. Products placed beyond the lines and levels of the required Work.
 5. Products remaining on hand after completion of the Work.
 6. Loading, hauling and disposing of rejected Products.
 7. Removing rejected materials and/or work and replacing with materials and/or work in compliance with these specifications.

1.6 GENERAL DESCRIPTION OF MEASUREMENT AND PAYMENT

- A. Measurement and Payment for the bid items listed in Base Bid shall be on the basis of the description in the Technical Specifications and Drawings. Unless the work to be done is so specifically called out to be measured and paid for in Base Form, payment for such work shall be included in other applicable items, and there shall be no separate measurement and payment for the work.
- B. Items listed in EJCDC C-410 – Bid Form as lump sum (L.S.) shall include all work for the complete installation as generally described in the Drawings and the Technical Specifications.
- C. Payment shall be made at the contract bid price listed in the Bid Form. Progress payments based on Schedule of Values, reference Section 01 23 00.
- D. Partial payment for unit price bid items and lump sum bid items only partially completed at the end of monthly pay periods shall be made based upon the Engineers interpretation of the percentage of work completed. Partial payment for materials delivered and stored will be considered, if said materials have been submitted to the Engineer for review per Section 01 33 00 – Submittal Procedures and supporting invoices and documentation have been provided.
- E. Quantities indicated in the Bid Form are for bidding and contract purposes only, unless specified otherwise in the Technical Specifications.
- F. If the actual work requires more or fewer quantities than those quantities indicated in the Bid Form, the Contractor shall provide the required quantities.
- G. Payment Includes: Full compensation for all required labor, products, tools, equipment, materials, transportation, services and incidentals, erection, application or installation of an item of the Work, including mobilization, demobilization, supervision, overhead and profit.

-
- H. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the Engineer multiplied by the unit price for work which is incorporated in or made necessary by the Work unless specified otherwise.

1.7 ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work.

1.8 SCHEDULE OF BID ITEMS

A. Schedule A: BASE BID

1. Item A1: Mobilization, PM, OH&P
 - a. Basis of Measurement: Lump Sum
 - b. Basis of 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 mobilization, demobilization, permitting, project management, environmental compliance, quality control, inspections, testing, submittals, contractor overhead and profit, and other construction management related activities and shall include coordination with the Owner, vendors, and other Contractors noted in the Contract Documents; progress meetings, and project administration.
2. Item A2: Lagoon 3 Liner Support
 - a. Basis of Measurement: Lump Sum
 - b. Basis of 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 and operator for staging and storing the liner, excavating a trench for liner installation, removing and replacing the inlet pad, installing the outlet pad, liner installation, and any other support needed to install the liner. This item excludes subgrade preparation and work included in C1, C2, C3, and C4.
3. Item A3: Lagoon 3 Cushion Layer, 6" Sand
 - a. Basis of Measurement: Lump Sum
 - b. Basis of 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 to furnish and install a sand layer of 6" depth as a cushion layer for the Geomembrane liner.

After bid award, Owner reserves the right to replace item A3 with item C3 in its entirety to reduce project costs.

4. Item A4: Septage Receiving Station and Tank

a. Basis of Measurement: Lump Sum

b. Basis of 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 the furnishing and installation of the septage receiving pad, precast holding tank, doghouse manhole on the main sewer line, and all other items necessary for a complete and functional septage receiving station.

5. Item A5: Headworks Building and Equipment

a. Basis of Measurement: Lump Sum

b. Basis of 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 to manufacture, construct, deliver, install, etc. all components of the headworks building and equipment depicted in volumes I-III and shall include building excavation, subgrade preparation, compliance with geotechnical engineering report, building foundation, floors, walls, roof systems, metals, finishes, coatings, thermal and moisture protections, piping, valves, fixtures, mechanical HVAC/plumbing/odor control piping, mechanical equipment, furnishings, and all building related architectural, structural, mechanical equipment, and process components including coordination with the Owner, vendors, and other Contractors noted in the Contract Documents; and all other items of expense for a complete and functional headworks building per the Contract Documents. All other items not specifically mentioned within previous categories but required for a complete and fully functional headworks facility to be included in this item, including project startup, commissioning, compliance, training, and testing. Excluded in this item are electrical, controls, and instrumentation. See item B1.

B. Schedule B: MANUFACTURERS & SUPPLIERS OF MAJOR EQUIPMENT & MATERIAL ITEMS

1. Item B1: Screening Equipment

a. Basis of Measurement: Lump Sum

b. Basis of 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. The deduct and add amounts listed are "installed" prices and take into consideration and include any cost of the design or construction changes that may be required as a result of using the alternate equipment, in addition to the cost of furnishing the alternate equipment.

C. Schedule C: ADDITIVE ALTERNATIVES

1. Item C1: Lagoon 3 Clear and Grub

a. Basis of Measurement: Standard Union Crew Daily Hours

i. Crew Type: B-10C with Dozer, daily hours

b. Basis of Payment: Unless otherwise itemized separately in the Unit Price Schedule, Payment will be made at the unit price based on agreed upon Schedule of Values submitted by the Contractor. City staff will clear and grub to the best of their ability. Contractor shall perform additional clearing and grubbing at an hourly rate as required by the liner supplier to address any deficiencies prior to liner installation. Included in this item are all costs to clear and grub Lagoon cell 3 for preparation of the geomembrane liner including equipment and labor.

2. Item C2: Lagoon 3 Subgrade Compaction

a. Basis of Measurement: Standard Union Crew Daily Hours

i. Crew Type: B-10A With Roller, daily hours

b. Basis of Payment: Unless otherwise itemized separately in the Unit Price Schedule, Payment will be made at the unit price based on agreed upon Schedule of Values submitted by the Contractor. City staff will prepare and compact subgrade to the best of their ability. Contractor shall perform additional subgrade preparation at an hourly rate as required by the liner supplier to address any deficiencies prior to liner installation. Included in this item are all costs to compact the subgrade to a minimum of 90% compaction or as otherwise required by the liner installer including equipment and labor.

3. Item C3: Lagoon 3 Cushion Layer, 12 oz. Geotextile

a. Basis of Measurement: Lump Sum

b. Basis of 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 to furnish and install a 12 oz. geotextile fabric layer as a cushion layer for the Geomembrane liner.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

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SECTION 01 33 00 SUBMITTAL PROCEDURES

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Construction progress schedules.
2. Proposed products list.
3. Shop drawings.
4. Product data.
5. Samples.
6. Manufacturers' instructions.
7. Manufacturers' certificates.

B. Related Sections:

1. Section 01 22 00 – Measurement and Payment.
2. Section 01 40 00 – Quality Requirements.
3. Section 01 70 00 – Execution and Closeout Requirements.

1.2 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer accepted form.
- B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail name or number(s), and specification Section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents. Submittals without the Contractor's stamp will not be reviewed and will be returned to the Contractor.
- E. Schedule submittals to expedite the Project and deliver to Engineer at 392 E Winchester St. Ste 300, Salt Lake City, UT 84107. Electronic submittals in PDF format are preferred. Coordinate submission of related items.

- F. Identify variations from Contract Documents and Product or system limitations, which may be detrimental to successful performance of the completed Work.
- G. Provide project specification relating to submittal with all notes, exceptions, and limitations clearly marked. Submittals will be automatically rejected if missing reference specification. If no exceptions taken to specifications, so indicate.
- H. Provide space for Contractor and Engineer review stamps.
- I. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- J. Distribute copies of reviewed submittals to affected parties. Instruct parties to promptly report any inability to comply with provisions.

1.3 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial progress schedule in duplicate within 10 days after date established in Notice to Proceed for Engineer review. Submit progress schedule no later than pre-construction conference.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- E. Indicate estimated percentage of completion for each item of Work at each submission.
- F. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

1.4 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Owner Contractor Agreement, submit complete 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.

1.5 SHOP DRAWINGS

- A. Submit the number of opaque reproductions that Contractor requires and one (1) electronic copy, which will be retained by Engineer.

- B. After review, distribute in accordance with Article on Procedures above and for Record Documents described in Document C-700 General Conditions.

1.6 PRODUCT DATA

- A. Submit the number of copies that the Contractor requires and one (1) electronic copy, which will be retained by the Engineer.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. Provide product data sheets, brochures, and technical data with submitted items clearly marked, and cross out items not included in submittal. Data sheets missing identifying information will be automatically rejected.
- D. After review, distribute in accordance with Article on Procedures above and provide copies for Record Documents described in Document C-700 General Conditions.

1.7 MANUFACTURERS' INSTRUCTIONS

- A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start up, adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.8 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification Sections, submit manufacturer's certificate to Engineer for review, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product but must be acceptable to Engineer.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

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SECTION 01 40 00 QUALITY REQUIREMENTS

PART 1. GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quality assurance/control of installation.
 - 2. References.
 - 3. Inspection and testing laboratory services
 - 4. Manufacturers' field services and reports.
- B. Related Sections
 - 1. 01 33 00 Submittal Procedures.
 - 2. 01 42 19 Reference Standards.
 - 3. 01 60 00 Product Requirements.

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.

1.3 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.

1.4 INSPECTION AND TESTING LABORATORY SERVICES

- A. Contractor shall employ and pay for the services of an independent testing laboratory acceptable to the Engineer, where specified in individual specification sections.
- B. Reports will be submitted by independent firm to the Engineer, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents. Contractor shall pay for all testing services.
- C. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm. Payment for retesting shall be by the Contractor.

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. Individuals to report 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.

1.6 PROJECT LIMITS

- A. Confine all work, equipment, tools, and materials to the easements and property boundary shown on the plans, unless otherwise authorized in writing by the Engineer.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 52 00 CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary Utilities
- B. Temporary Controls: Barriers, Water Control, Dust Control, Erosion and Sediment Control, Pollution Control, And Noise Control
- C. Protection: Security, Tree and Plant Protection, and Protection of Installed Work
- D. Construction Facilities: Access Roads, Parking and Staging Areas
- E. Progress Cleaning
- F. Removal of Utilities, Facilities and Controls
- G. Pedestrian and Operations Staff Access
- H. Permits

1.2 RELATED SECTIONS

- A. Section 01 11 00 –Summary of Work: Contractor use of site and premises
- B. Section 01 70 00 – Execution and Closeout Requirements: Final cleaning

1.3 TEMPORARY UTILITIES

- A. Provide and maintain a supply of suitable quality water as required to comply with specified conditions for construction operations. Water for project work, including testing, dust control, etc. may be obtained from an existing Mt Pleasant City fire hydrant. Owner will provide a reasonable amount of water at no cost to the Contractor. Contractor shall provide a backflow prevention device and meter the water.
- B. Provide and maintain required sanitary facilities and enclosures. Fixed or portable chemical toilets shall be provided by the Contractor, wherever needed, for the use by employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.
- C. The Contractor shall establish a regular collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor, or organic material wastes from any other source related to the Contractor's operations, shall be

disposed of away from the site in accordance with all laws and regulations pertaining thereto. Disposal of all such wastes shall be at the Contractor's expense.

- D. Provide and maintain temporary electricity as needed for construction. Contractor may utilize the existing power service for work; however, all of Contractor's electrical use shall be coordinated with operation's staff. Larger power demands will require the use of a contractor-provided generator.

1.4 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of site, to protect public safety, and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide protection for plant life designated to remain. Replace damaged plant life.
- C. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

1.5 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment as needed.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion and puddling.
- C. Contractor shall follow BMPs for dewatering activities.

1.6 DUST CONTROL

- A. This item shall consist of furnishing and applying POTABLE water required in construction and for dust control, in accordance with the requirements of these specifications.
- B. Water, when required, shall be applied at the locations and in the amounts required to properly compact the work. An adequate water supply shall be provided by the Contractor. The equipment used for watering shall be of ample capacity and of such design as to assure uniform application of water in the amounts required.
- C. If possible, watering shall be done at times when evaporation loss will be at a minimum.
- D. In watering of subgrades, the Engineer may request the Contractor to apply water in such quantities that the subgrade shall be compacted at a moisture content in excess of "optimum moisture." In no case will the Contractor be required to apply water in excess of three percent (3%) of optimum moisture.
- E. The Contractor shall also apply water during the course of the work to control dust, maintaining all embankment and base courses in a damp condition.

- F. The Contractor shall provide sufficient equipment to apply water as directed for controlling dust caused by construction activities. If dusty conditions continue to exist due to insufficient or inadequate watering practices or lack of watering equipment, it shall cause the closing down of those operations affected until remedied. Watering shall be done on Saturdays, Sundays, and Holidays at the same frequency and amounts as specified for work days at the Contractor's expense.
- G. Watering equipment shall consist of water-tight tanks mounted on trucks, adequately powered, and capable of applying water as required. The water shall be applied under pressure from the tank through a spray apparatus as directed. The spray apparatus shall be equipped as to provide uniform, unbroken spread of water over the surface being watered. A suitable device for positive shut-off and for regulating the flow of water shall be located so as to permit positive drive control from the cab.

1.7 EROSION AND SEDIMENT CONTROL

- A. Contractor shall comply with all provisions noted the United States Environmental Protection Agency, including, but not limited to, the Utah Pollutant Discharge Elimination System (UPDES) Storm Water General Permit for Construction Activities (**SEE LINK BELOW**) and the Construction Storm Water Pollution Prevention Plan (SWPPP).

<https://deq.utah.gov/water-quality/general-construction-storm-water-updes-permits>
- B. Contractor shall submit all required elements, including a Notice of Intent (NOI), and complete the UPDES Permit (as necessary) and SWPPP for Engineer's review prior to construction (a project map will be provided to Contractor to use for the SWPPP). The SWPPP must be submitted for Engineer review and Owner's approval prior to filing the NOI. Construction will not be permitted without Engineer's review and Owner's approval. Contractor shall comply with all requirements of the UPDES General Permit and SWPPP or such additional requirements as may be required throughout construction as specified by the Utah Division of Water Quality. Engineer and Owner shall not be responsible for Contractor's failure to maintain compliance with such permits or additional requirements.
- C. Plan and execute construction methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- D. Minimize amount of bare soil exposed at one time.
- E. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
- F. Construct fill and waste areas by selective placement to avoid erosion of surface materials.
- G. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.8 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- B. Protect and drainage ditches from surface runoff during construction operations.
- C. Equipment and fuel storage shall be kept secured. Waste oil and waste fluids shall not be stored or changed at any construction site.
- D. Spills of hazardous or toxic materials shall be promptly reported to the Utah Division of Environmental Quality. Contractor shall take emergency measures to limit the amount of the releases at Contractor's own expense.

1.9 SECURITY

- A. Provide security and temporary fencing of facilities to protect work from unauthorized entry, vandalism or theft.

1.10 NOISE CONTROL

- A. Construction involving noisy operations, including starting and warming up of equipment, shall be restricted to the hours noted in Section 01 11 00. Noisy operations shall be scheduled to minimize their duration and to ensure their completion within the contract working hours.
- B. Notification of special circumstances or emergency conditions that require work beyond the hours specified above shall be provided as follows:
 - 1. The Contractor shall notify the Engineer 48 hours in advance of any proposed extended work hours for preauthorization. Notification shall include a written request for authorization to perform work specified and the circumstances that warrant this request. This notification shall include any additional measures to mitigate noise generated by this construction activity if deemed necessary by the Engineer.
 - 2. If an emergency situation occurs that warrants extended hours, the Contractor shall notify the Engineer immediately upon determining the need for this work.

1.11 TREE AND PLANT PROTECTION

- A. **CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS:** All landscaped areas and other surface improvements which are damaged by actions of the Contractor shall be restored to a condition equal to or better than it was prior to construction. Areas shall not be cleared until related construction activities require the work.

1.12 PROTECTION OF INSTALLED WORK

- 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 minimize damage.

1.13 ACCESS ROADS

- A. Construct and maintain temporary roads accessing public thoroughfares to serve construction area. Contractor shall provide temporary roadways when construction activities limit the Owners access and use of existing roads or access to buildings.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Provide and maintain access for emergency vehicles, mail delivery, trash pickup, etc.
- D. Provide and maintain access to existing driveways and approaches to private residences.
- E. Provide means of removing mud from vehicle wheels before entering streets.
- F. All vehicular access shall be coordinated with and approved by Owner.

1.14 PARKING AND STAGING AREAS

- A. Do not allow construction personnel to park in any way which may affect the access and egress of plant personnel, deliveries, emergency vehicles, etc. The Contractor shall provide a separate parking area for Contractor's personnel and equipment within the designated Staging Area. Provide off-site parking as necessary in compliance with local requirements.
- B. Contractor to coordinate with the Owner and identify the staging area at the site.

1.15 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Establish regular intervals of collection and disposal of such materials and waste.
- B. At no additional cost to Owner, remove waste materials, debris, and rubbish from the site and dispose it off-site at a solid waste facility in accordance with local codes and ordinances governing locations and methods of disposal.
- C. Provide necessary containment and clean-up of all hazardous/dangerous materials on-site that result from Contractor's actions.
- D. Dispose of all hazardous/dangerous waste in approved hazardous waste facilities that result from Contractor's actions.

1.16 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.17 PEDESTRIAN AND OPERATIONS STAFF ACCESS

- A. Provide access by pedestrian and operations staff foot traffic to the facility during construction.
- B. Protect pedestrians and operations staff from potentially dangerous areas by barricades, walkways, signs, or other means as appropriate and necessary.

1.18 PERMITS

- A. Obtain a building permit from Mt Pleasant City Building Department.
- B. Contractor shall obtain all other required permits.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

**SECTION 01 60 00
PRODUCT REQUIREMENTS**

PART 1. GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Products.
 - 2. Transportation and handling.
 - 3. Storage and protection.
 - 4. Product options.
 - 5. Substitutions.
- B. Related Sections:
 - 1. EJCDC C-200 – Instructions to Bidders.
 - 2. Section 01 40 00 – Quality Requirements.

1.2 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work. Products may also include existing materials or components required for reuse.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- C. Provide interchangeable components of the same manufacturer, for similar components.

1.3 TRANSPORTATION AND HANDLING

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged. Replace damaged products at no additional cost to OWNER.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 STORAGE AND PROTECTION

-
- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather tight, climate-controlled enclosures.
 - B. For exterior storage of fabricated products, place on sloped supports, above ground.
 - C. Provide off site storage and protection when site does not permit on site storage or protection.
 - D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
 - E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 - 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 observation and documentation. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

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 manufacturers named and meeting specifications, no options or substitutions allowed unless stated otherwise. Submit a request for substitution for any manufacturer not named.

1.6 SUBSTITUTIONS

- A. Engineer will consider requests for Substitutions only within 30 days after date of Owner Contractor Agreement.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the Substitution as for the 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 for review or redesign services associated with re approval by Engineer and authorities.
- D. 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 the Contract Documents.
- E. Substitution Submittal Procedure:
1. Submit one (1) electronic copy by email to project engineer 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 the proposed product equivalence.
 3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

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SECTION 01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1. GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Closeout Procedures.
 - 2. Final Cleaning.
 - 3. Starting of Systems.
 - 4. Demonstration and Instructions.
 - 5. Project Record Documents.
 - 6. Spare Parts and Maintenance Materials.
 - 7. Product Warranties and Product Bonds.
- B. Related Sections:
 - 1. EJCDC C-700 – General Conditions.

1.2 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been observed and documented, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.
- B. Provide submittals to Engineer that are required by governing or other authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.3 FINAL CLEANING

- A. Execute final cleaning and surface restoration prior to final inspection.
- B. Clean site; rake clean landscaped surfaces.
- C. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- D. Fill in depressions or ruts as required to restore ground surface to original condition.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Owner and Engineer seven days prior to start-up of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative and in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01 33 00 – Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' 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 scheduled times, at equipment location.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change orders and other modifications to the contract.

5. Reviewed shop drawings, product data, and samples.
- B. Store Record Documents separate from documents used for construction.
- C. Record information concurrent with construction progress.
- D. 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.
- E. Record Documents 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. Details not on original Contract Drawings.
 4. Water quality testing information.
- F. Delete Engineer seal from all documents.
- G. Submit documents to Engineer with claim for final Application for Payment.

1.7 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual specification Sections.
- B. Deliver to Project site.

1.8 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 and in electronic (PDF) format.
- 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.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 73 24
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/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 and conform to criteria and design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the Drawings or where the size of attachments, anchorage, or bracing is defined in specific 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 D, E, or F where all of the following apply:
 - a. The component importance factor, I_p , 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
UOSH	Utah Occupational Safety and Health Act
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 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, 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, tanks, vessels and structural towers that support pipes, tanks and vessels.

1.4. SUBMITTALS

- A. Action Submittals:
 - 1. Procedures: Section 01 33 00.

2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to specification requirements, with the submittal is sufficient cause for rejection of the entire submittal with no further consideration.
4. For structural elements of non-structural components and non-building structures required to be designed per this section, provide Drawings and design calculations stamped by a Utah licensed professional engineer qualified to perform structural engineering.
5. List of non-structural components and non-building structures requiring seismic design and anchorage.
6. Shop drawings showing details of complete seismic bracing and anchorage attachment assemblies including connection hardware, and embedment into concrete.
7. Shop drawings showing plans, elevations, sections and details of equipment support structures and non-building structures, including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.
8. 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. Seller shall design anchor bolts, including embedment into concrete, and submit stamped calculations.
9. 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 Buyer:

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 Buyer and in conformance with International Building Code (IBC) Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Buyer 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.

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 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 :	1.54 g
1.0 Sec. Mapped Spectral Response, S_1 :	0.564 g
Site Class:	D
0.2 Sec. Design Spectral Response, S_{DS} :	0.97 g
1.0 Sec. Design Spectral Response, S_{D1} :	0.653 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	D

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. Design Considerations

1. Design non-structural components and non-building structures for the following conditions:
2. Climatic Conditions: Reference Section 01 11 80 – Environmental Conditions.

- E. 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 Buyer.
- 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 Buyer.

END OF SECTION

SECTION 01 75 16 STARTUP PROCEDURES

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Starting systems.
2. Demonstration and instructions.
3. Testing, adjusting, and balancing.

B. Related Sections:

1. Section 01 40 00 – Quality Requirements.
2. Section 01 70 00 – Execution and Closeout Requirements.
3. Section 01 78 23 – Operation and Maintenance Data.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION

3.1 STARTING SYSTEMS

- A. Coordinate schedule for start up of various equipment and systems.
- B. Notify Owner and Engineer seven days prior to start up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of responsible manufacturer's representative and in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start up, and to supervise placing equipment or system in operation.

- H. Submit a written report in accordance with Section 01 40 00 that equipment or system has been properly installed and is functioning correctly.

3.2 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel with a Demonstration or testing period.
- B. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' 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 scheduled times, at equipment location. The demonstration period should be organized to provide a clear, concise summary of the equipment operation and maintenance.
- D. Demonstrate the functional integrity of the mechanical, electrical, and control interfaces of the respective equipment and components comprising the facility or system as evidence of Substantial Completion.
- E. If, during the Demonstration Period, the aggregate amount of time used for repair, alternation, or unscheduled adjustments to any equipment or systems that render the affected equipment or system inoperative exceed 10 percent of the Demonstration Period, the demonstration of functional integrity will be deemed to have failed. In the event of failure, a new Demonstration Period will recommence after correction of the cause of failure. The new Demonstration Period shall have the same requirements and duration as the Demonstration Period previously conducted.
- F. Conduct the demonstration of functional integrity under full operational conditions.
- G. Owner reserves 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.
- H. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- I. Provide knowledgeable personnel to answer Owner's questions throughout the Demonstration Period.
- J. Provide final field instruction on select systems and respond to any system problems or failures that may occur.
- K. Provide all labor, supervision, utilities, chemicals, maintenance, equipment, vehicles, or any other item necessary to operate and demonstrate all systems being demonstrated

3.3 TESTING, ADJUSTING, AND BALANCING

- A. The Owner may record the startup and training sessions. The recording produced shall be the sole property of the Owner. Any additional testing and training time required to provide a complete and properly functioning installation shall be provided at no additional cost to the Owner.

END OF SECTION

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**SECTION 01 78 23
OPERATION AND MAINTENANCE DATA**

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quality Assurance.
2. Format.
3. Contents.
4. Manual for Equipment and Systems.
5. Instruction of Owner's personnel.
6. Submittals.

B. Related Sections:

1. 01 33 00 Submittal Procedures.
2. 01 40 00 Quality Requirements.
3. 01 60 00 Product Requirements.
4. 01 70 00 Execution and Closeout Requirements: project record documents.

C. Section 01 75 16 – Startup Procedures

D. Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.2 QUALITY ASSURANCE

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.3 FORMAT

- A. Prepare data in the form of a reference manual.
- B. Binders: Commercial quality, 8-1/2 x 11, three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related, consistent groupings

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- C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; Identify subject matter of contents.
 - D. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
 - E. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
 - F. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
 - G. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by components. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following where applicable:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Certificates.
 - c. Photocopies of warranties (and bonds).
 - 4. Part 4: Provide one (1) electronic format (Adobe Acrobat, .pdf) with searchable hyperlinks in a table of contents for each volume.

1.4 CONTENTS, EACH VOLUME

- A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

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- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
 - C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete or clearly and neatly cross out inapplicable or extraneous information.
 - D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 40 00 Quality Requirements.
 - F. Warranties: Bind in copy of each.
 - G. Bonds: Bind in photocopy of each.

1.5 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications by label machine.
- C. Include color coded wiring diagrams as installed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions; cleaning and coating; etc.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.

-
- K. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - L. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.6 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- C. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction

1.7 SUBMITTALS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit two (2) copies of complete volumes at least 30 days prior to final inspection. One copy will be reviewed and returned after final inspection, with Engineer comments. Revise content of all documents sets as required prior to final submission.
- D. Submit four (4) sets of revised final volumes in final form within 10 days after final inspection.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 79 00 OWNER STAFF TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. The SELLER and CONTRACTOR shall furnish all labor, materials, equipment, and incidentals necessary to train OWNER'S personnel on the equipment, products, and systems furnished under this Contract. OWNER training is a prerequisite to satisfactory completion of the Contract requirements and shall be completed within the Contract Time.
- B. This specification describes the general requirements and format for the training while individual equipment specifications detail specific training related to that equipment and supplements this specification.
- C. Except where otherwise indicated, all costs for training shall be the responsibility of the CONTRACTOR.

1.2 SUBMITTALS

- A. Training Schedule: Schedule for training the OWNER'S personnel shall be submitted with the detailed Testing and Startup Plan as a deferred submittal by CONTRACTOR.
- B. Resumes of instructors.
- C. The training lesson plan and materials shall be submitted to the ENGINEER for review at not less than 3 weeks prior to the provision of training.
- D. Approved operation and maintenance manuals shall be available at least 30 days prior to the scheduled date for the individual training session.
- E. Training Schedule: Training classes shall be scheduled a minimum of four (4) weeks in advance of the date of the first class to allow OWNER staffing arrangements to take place. The CONTRACTOR shall schedule training classes within the period 9:00 am to 5:00 pm Monday through Friday.
- F. Class Agenda: A class agenda shall be prepared by the CONTRACTOR and submitted to the ENGINEER with the training schedule. The agenda shall include a listing of subjects to be discussed, time estimated for each subject, a list of documentation to be used and provided to support training, the proposed route of the field tours, and the instructor(s) name and qualifications. Agendas shall include an allocation of time for all components of the training session, including time for OWNER staff to ask questions and discuss the subject matter. The OWNER may request that particular subjects are emphasized and the agenda shall be adjusted to accommodate these requests. Copies of the agenda shall be distributed to each student at the beginning of each training class.

- G. Within ten (10) days after the completion of each training session, the CONTRACTOR shall submit the following:
- H. A sign-in sheet of all personnel that attended the training session.
- I. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.
- J. A flash drive with files containing the above information.

1.3 INSTRUCTOR QUALIFICATIONS

- A. Instructors shall be completely knowledgeable in the products and systems for which they are providing training and shall be experienced in conducting classes. Sales representatives are not considered qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
- B. Instructor shall have at least two years of experience in providing training certified by the Manufacturer.
- C. If, in the opinion of the OWNER, the Instructor did not provide the scheduled training, such training shall be rescheduled and repeated with a suitable instructor at the CONTRACTOR's expense.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Where specified, the CONTRACTOR shall coordinate and conduct training sessions for the OWNER'S personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this Contract.

2.2 TRAINING AIDS

- A. Each instructor is encouraged to use audio-visual devices, P&IDs, models, charts, or other means to effectively increase the transfer of knowledge. The instructor conducting the training shall furnish all such equipment (televisions, CD/DVD recorder/player, projectors, screens easels, etc.), models, and charts for each class. It shall be the responsibility of the instructor to confirm in advance that the classroom will be appropriate for the types of audio-visual equipment to be employed.

2.3 LOCATION

- A. Training sessions shall take place at OWNER's conference room, except for field training on the actual equipment which shall occur at the Project Site.

2.4 FORMAT AND CONTENT

- A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

2.5 FAMILIARIZATION

- A. Review catalog, parts lists, drawings, etc., which have been previously provided for the OWNER'S files and operation and maintenance manuals.
- B. Inspection on how the equipment has been installed. Demonstrate the operation of the unit and describe how all parts of the equipment meet the requirement of the Specifications.
- C. Answer questions.

2.6 SAFETY

- A. Using material previously provided, review safety features of the equipment.
- B. Discuss proper precautions when working around equipment.

2.7 OPERATION

- A. Using material previously provided, review reference literature.
- B. Explain all modes of operation (including emergency).
- C. Check out OWNER'S personnel on proper use of the equipment.

2.8 PREVENTIVE MAINTENANCE

- A. Using material previously provided, review preventive maintenance (PM) lists including:
 - 1. Reference material.
 - 2. Daily, weekly, monthly, quarterly, semiannual, and annual PM activities.
 - 3. Demonstrate how to perform Preventive Maintenance procedures.
 - 4. Demonstrate to the OWNER'S personnel what to look for as indicators of potential equipment problems.
 - 5. Corrective Maintenance
 - 6. Identify possible problems.
 - 7. Demonstrate how to perform repairs. Point out special problems.
 - 8. Open up equipment and demonstrate O & M procedures, where practical.

2.9 PARTS

- A. Demonstrate the use of previously provided parts list and order parts.
- B. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.

2.10 LOCAL REPRESENTATIVES

- A. Identify local vendors where to order parts: name, address, telephone.
- B. Service problems:
- C. Identify contacts local contacts.
- D. Identify emergency contacts.

2.11 OPERATION AND MAINTENANCE MANUALS

- A. Review any other material submitted.
- B. Update material, as required.

PART 3 - EXECUTION

3.1 GENERAL

- A. The objective of the training included under this Section shall be to convey the knowledge needed by the OWNER operations, maintenance, and engineering staff to safely operate, maintain, and repair the equipment and systems furnished under this CONTRACT.
- B. OWNER personnel who will participate in this training have existing full-time work assignments and this training is an additional assigned work task. OWNER'S staff work schedules regularly shift, as the plant is operated on an around-the-clock basis.
- C. Training shall be tailored to suit the skills and job classifications of the personnel attending the classes e.g., plant manager, plant operator, maintenance technical, electrician, etc.
- D. Minimum onsite training requirements for plant components are described in various sections of the Specifications. For the purpose of the times given in individual Specification sections, a workday is defined as an eight (8) hour day at the site, excluding travel time.
- E. Training shall be scheduled as a separate trip from equipment inspection, startup, and field adjustment. Training shall not be done until the manufacturer certifies that the equipment is operable as specified.

- F. Training shall be coordinated with OWNER schedule by CONTRACTOR to avoid conflicts with other work or scheduled training.
- G. Specific Training Objectives:
 - 1. The training shall include a review of the equipment and drives, including internal parts, as prepared at the factory.
 - 2. The training shall include safety, removal, inspection, cleaning, operation and maintenance of the equipment such as startup, normal operation and shutdown procedures, step-by-step troubleshooting procedures with all necessary test equipment, and emergency or abnormal operation procedures.
 - 3. Training shall include preventive maintenance and long-term maintenance procedures, special tools necessary, and a discussion of recommended spare parts.
- H. Cancellation of Classes: If a class must be canceled because the equipment is not ready for operation, etc. the CONTRACTOR shall notify the OWNER at least one (1) week in advance. The CONTRACTOR shall coordinate with the OWNER to reschedule the training.

3.2 DOCUMENTATION OF TRAINING

- A. The CONTRACTOR shall furnish all materials in accordance with submittals.
- B. The OWNER reserves the right to videotape, photograph, audio record, and otherwise document any or all training classes provided under this WORK.

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 22 00 – Measurement and Payment
 - 2. Section 03 30 00 – Cast-In-Place Concrete
 - 3. Section 04 01 00 – Maintenance of Masonry

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 A996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
 4. ASTM C33 - Standard Specification for Concrete Aggregates.
 5. ASTM C109 - Standard Test Method for Compressive strength of Hydraulic Cement Mortars (Using 2-in. or (50 mm) Cube Specimens).
 6. ASTM C150 - Standard Specification for Portland Cement.
 7. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 8. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
 9. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 10. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
 11. ASTM C1042 - Standard Test Method for Bond Strength of Latex Systems Used With Concrete By Slant Shear.
 12. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
 13. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
 14. 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 – Execution and 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/C109M; 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 particular 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 apply 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 Requirements: 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 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 gage 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 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 in 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 where 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 bottoms 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 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 Contractor. Submit test reports to 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 Requirements: 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 31 19 – Project Meetings.
- B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615, 60 kilopounds 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 gage 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 and 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. Mitigation for aggregate Alkali-Silica Reaction (ASR).
 - 1. For aggregate source with non-reactive materials. Submit verification that selected source of aggregate is not susceptible to alkali-silica-reaction (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 31 19 – Project 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:
 - 1. ASTM C150, Type I or II
 - 2. ASTM C595, Type IL(10)(MS)
- B. Fine and Coarse Aggregates: $\frac{3}{4}$ -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 (HRWR) Water Reducing 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.

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. Total slumps shall not exceed 10" 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. Concrese liquid bonding adhesive (LPL) two-component, liquid epoxy bonding agent.
- B. No substitutes.

2.7 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, coarse aggregate, fly ash and admixtures formulated to be flowable and self-consolidating with a net 28-day compressive strength of 200 to 300 psi.

2.8 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.

2.9 MISCELLANEOUS CONCRETE PADS

- A. Miscellaneous concrete pads such as 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.

2.10 FOUNDATIONS AND STRUCTURAL CONCRETE

- A. As noted in the General Structural Notes and Specifications, as shown on the Drawings.
 - 1. M3000-INT for interior concrete floor slabs-on-grade.
 - 2. M4500-STD for concrete footings, walls, elevated slabs, beams and columns

2.11 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 – Work Summary.
- 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. Place slurry mix 2-inch minimum to 4-inch maximum in thickness.
 2. 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.
 3. Place concrete over slurry mix while slurry mix is still flow-able.
 4. Limit initial concrete placement on top of slurry mix to 12-inches in thickness. Thoroughly vibrate and consolidate concrete and slurry mix together.

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, 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 1/4 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-001.
- 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. 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") 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") and less than or equal to .095 inches (3/32") 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") 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. Finishing concrete floors and surfaces.
 - 2. Floor surface treatment and hardeners.

- B. Related Sections:
 - 1. Section 01 22 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
 - 5. Division 9 – Finishes

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 – Execution and 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: Product storage and handling requirements.
- B. Deliver materials in manufacturer's packaging including application instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements: Environmental conditions affecting products on site.
- 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: Coordination and project conditions.
- 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: Coordination and project conditions.
- 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-001.
- 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-001

3.5 TOLERANCES

- A. Section 01 40 00 – Quality Requirements: 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 1
 - 2. Division 3

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 – Execution and 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 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 22 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 Surfacing.
 - 6. ASTM C531 - Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
 - 7. ASTM C579 - Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, monolithic Surfacing 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:
 - 1. ASTM C150, Type II.
 - 2. ASTM C595, Type IL(10)(MS)
- 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 2 to 3 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. The Masonry Society (TMS):
 - 1. TMS 402 - Building Code Requirements for Masonry Structures.
 - 2. TMS 602 - 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 TMS 402 and TMS 602 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 TMS 602 when ambient temperature or temperature of masonry units is less than 40°F.
- C. Hot Weather Requirements: In accordance with TMS 602 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 – Execution and 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 & Owner 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, or ASTM C595 equal, color by client
- 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 7
 - 6. Division 9

1.2 REFERENCE STANDARDS

- A. The Masonry Society (TMS):
 - 1. TMS 402 - Building Code Requirements for Masonry Structures.
 - 2. TMS 602 - 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:
 - 1) ASTM E 514, Extended to 72 hours.
 - 2) ASTM C 1357
 - 3) ASTM C 1314
 - 4) 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 as indicated in the Structural 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 Section 09 96 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: Rheapel 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 by the use of 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: Submit to Engineer for review.
- 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 in excess of 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 TMS 602.

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 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 TMS 602.
 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 TMS 602 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 – Execution and 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 – Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Hot and Cold Weather Construction: Perform Work according to TMS 602, 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

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-premise 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 premise 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 conforming 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.
- 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 rang 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 a distance of six feet.

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 Requirements: 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 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 form 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 Requirements: Tolerances.
- B. Maximum Variation from Plumb: $\frac{1}{4}$ inch per story, non-cumulative.
- C. Maximum Offset from Alignment: $\frac{1}{4}$ inch.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements.
- 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

SECTION 05 21 00 STEEL JOIST FRAMING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Open web steel joists, with bridging, attached seats and anchors.
 - 2. Loose bearing plates and anchor bolts for site placement.
 - 3. Framed roof openings greater than 18 inches.

- B. Related Requirements:
 - 1. Section 05 12 00 – Structural Steel
 - 2. Section 05 32 00 – Steel Roof Decking
 - 3. Section 05 04 10 – Hop Dip Galvanizing

1.2 REFERENCE STANDARDS

- A. American Institute of Steel Construction (AISC):
 - 1. AISC 341 - Seismic Provisions for Structural Steel Buildings.

- B. ASTM International (ASTM):
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 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 A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - 6. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
 - 7. ASTM A449 - Standard Specification for Quenched and Tempered Steel Bolts and Studs.
 - 8. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 9. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.

10. ASTM F436 - Standard Specification for Hardened Steel Washers.
 11. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 12. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
- C. American Welding Society (AWS):
1. AWS D1.1 – Structural Welding Code – Steel.
- D. Steel Joist Institute (SJI):
1. SJI K-1.1 - Standard Specifications for Open Web Steel Joists, K-series.
 2. SJI LH/DLH-1.1 - Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series.

1.3 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal requirements.
- B. Shop Drawings:
1. Indicate standard designations, configuration, sizes, spacing, locations of joists, joist leg extensions.
 2. Joist coding, bridging, connections, attachments, and cambers.
 3. Connection details.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- D. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
1. SJI K-1.1, SJI LH/DLH-1.1, and SJI JG-1.1, including headers and other supplementary framing.
 2. AISC 341 Seismic Provisions for Structural Steel Buildings.

1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in performing Work of this section with minimum five years of documented experience.

- B. Erector: Company specializing in performing Work of this section with minimum five years of documented experience.
- C. Design connections not detailed on drawings under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of Utah.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Open Web Joists Members: SJI Type K or LH Longspan or DLH Deep Longspan as indicated on the Drawings.
- B. Bolts: ASTM A325; Type 1, HDG, or Type 3, HGD; heavy hex, structural type.
- C. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: HDG.
- D. Washers: ASTM F436; Type 1, circular or beveled as required. Furnish clipped washers where space limitations require.
 - 1. Finish: HDG.
- E. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36.
- F. Welding Materials: AWS D1.1; type required for materials being welded.
- G. Coatings:
 - 1. Provide Hot Dipped Galvanizing per Specification 05 04.

2.2 FABRICATION

- A. Furnish bottom and top chord extensions as indicated on Drawings.
- B. Fabricate to achieve end bearing as indicated on the Drawings.

2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Testing, inspection and analysis requirements.
- B. Furnish shop testing and analysis of steel sections.

- C. When fabricator is approved by authority having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify bearing plates are set to required location and elevation.
- C. Verify bearing surfaces are ready to receive joists.

3.2 ERECTION

- A. Erect and bear joists on supports.
- B. Allow for erection loads. Install sufficient temporary bracing to maintain framing safe, plumb, and in alignment.
- C. Coordinate placement of anchors in concrete construction for securing bearing plates or angles.
- D. After joist alignment and installation of framing, field weld joist seat to bearing plates or angles.
- E. Position and field weld joist chord extensions and wall attachments as detailed.
- F. Frame floor and roof openings greater than 18 inches with supplementary framing.
- G. Do not permit erection of decking until joists are braced, bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- H. Do not field cut or alter structural members without approval of Engineer.
- I. After erection, touch-up and repair galvanize per Specification 05 04 10.

3.3 TOLERANCES

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Maximum Variation From Plumb: $\frac{1}{4}$ inch.
- C. Maximum Offset From Alignment: $\frac{1}{4}$ inch.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Requirements for inspecting, testing.
- B. Section 01 70 00 – Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Field inspect members, connections, welds, and tightening of high strength bolts in slip-critical connections.

END OF SECTION

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SECTION 05 32 00 STEEL ROOF DECKING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel roof deck and accessories.
 - 2. Framing for openings up to and including **18** inches.
- B. Related Sections:
 - 1. Section 05 12 00 – Structural Steel
 - 2. Section 05 21 00 – Steel Joist Framing: Support framing for deck openings.
 - 3. Section 09 96 00 – Protective Coatings (*including preparation of decking for paint and coatings*)

1.2 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 3 - Standard Practice for the Construction and Inspection of Composite Slabs.
- B. ASTM International:
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Baked Hardenable.
- C. American Welding Society (AWS):
 - 1. AWS D1.1 - Structural Welding Code - Steel.
- D. Steel Deck Institute (SDI):
 - 1. SDI 29 - Design Manual for Composite Decks, Form Decks and Roof Decks.
- E. The Society for Protective Coatings (SSPC):
 - 1. SSPC Paint 15 - Steel Joist Shop Paint.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate deck plan, support locations, Projections, openings and reinforcement, pertinent details, and accessories.
- C. Product Data: Submit deck profile characteristics and dimensions, structural properties and finishes.
- D. Manufacturer's Installation Instructions: Submit manufacturer's installation instructions.
- E. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ASCE 3 for composite decks.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this Section with minimum five years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Cut plastic wrap to encourage ventilation.
- C. Store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Sheet Steel: ASTM A653, Grade 50 Structural Quality; with G90 galvanized coating.
- B. Bearing Plates or Angles: ASTM A36.
- C. Welding Materials: AWS D1.1.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic.

2.2 ACCESSORIES

- A. Flute Closures: Closed cell foam rubber one inch thick; profiled to fit tight to deck.

- B. Sump Pans and plates: Fabricated of metal of same type and finish as deck.

2.3 FABRICATION

- A. Metal Deck: Sheet steel, configured as follows:
 - 1. Span Design: multiple.
 - 2. Minimum Metal Thickness Excluding Finish: 20 gauge. G-90 Galvanized Coating
 - 3. Minimum Section Properties (per foot width): $S=0.224 \text{ in}^3$, $I=0.197 \text{ in}^4$.
 - 4. Nominal Height: 1-1/2 inch fluted profile WR.
 - 5. Formed Sheet Width: 24 inch minimum.
 - 6. Side Joints: lapped.
 - 7. Flute Sides: plain vertical face.
- B. Related Deck Accessories: Metal closure strips, cover plates, cant strips, 22 gauge thick galvanized sheet steel; of profile and size as indicated on drawings.
- C. Roof Sump Pan or Plate: Fabricate of 14 gage sheet steel, flat bottom, sloped sides, recessed 1-1/2 inches below roof deck surface, bearing flange 3 inches wide, sealed watertight.
- D. Fasteners: Galvanized hardened steel, self-tapping.
- E. Weld Washers: Mild steel, uncoated, 3/4 inch outside diameter, 1/8 inch thick.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Erect metal deck in accordance with SDI Manual.
- B. Bear deck on steel supports with 1-1/2 minimum bearing. Align and level.
- C. Fasten roof deck to steel support members at ends and intermediate supports as noted on the Drawings.
- D. Weld in accordance with AWS D1.1.
- E. Mechanically clinch or fasten male/female side laps as specified on the Drawings.
- F. Seal deck joints, laps, ends, and penetrations with sealant to achieve permanent air seal consistent with air barrier system specified in Section 07 92 13.
- G. Reinforce steel deck openings from 6 to 18 inches in size with 2- by 2- by ¼-inch steel angles. Place framing angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld or mechanically attach to deck at each flute.

- H. Install 6 inch minimum wide sheet steel cover plates, of same thickness as deck, where deck changes direction. Fusion weld or mechanically attach 12 inches on-center maximum.
- I. Install single row of foam flute closures above walls and partitions perpendicular to deck flutes.
- J. Position roof sump pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- K. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up prime paint.

3.2 FIELD QUALITY CONTROL

- A. Welding: Inspect welds in accordance with AWS D1.1.

END OF SECTION

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 - Holo-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.

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 Requirements: 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

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 22 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.

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 05 53 00 METAL GRATINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Formed floor gratings.
 - 2. Perimeter closure.

- B. Related Requirements:
 - 1. Section 01 22 00 – Measurement and Payment
 - 2. Section 03 30 00 – Cast-in-Place Concrete
 - 3. Section 05 50 00 – Metal Fabrications
 - 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 A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A1011 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.

- B. American Welding Society (AWS):
 - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - 2. AWS D1.1 - Structural Welding Code - Steel.

- C. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. NAAMM MBG 531 - Metal Bar Grating Manual.
 - 2. NAAMM MBG 532 - Heavy-Duty Metal Bar Grating Manual.

- D. 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 Primer/Metal Building Primer.
5. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

1.3 COORDINATION

- A. Coordinate Work of this Section with placement of ledgers and supports.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit span and deflection tables.
- C. Shop Drawings: Indicate details of gratings, plates, component supports, anchorages, openings, fasteners, perimeter construction details, and tolerances. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for gratings.

1.5 QUALIFICATIONS

- A. Welders and Welding Procedures: AWS D.1 qualified within previous 12 months for employed weld types.
- B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed at Project location.

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. Design Live (Pedestrian) Load: Uniform load of 100 pounds/square foot minimum; concentrated load of force 300 pounds.
- B. Design Live (Light Vehicle) Load: Uniform load of 500 pounds/square foot minimum; concentrated load of force 2,000 pounds.
- C. Maximum Allowable Deflection under Live Load: 1/240 of span; size components for single span.
- D. Maximum Center to Center Bar Spacing: 1-3/16 inch.

2.2 GRATINGS AND FLOOR PLATES

- A. Manufacturer List:
 - 1. McNichols Type GW steel grating
 - 2. Grating Pacific Type W steel grating.
 - 3. Marco Type W steel grating.

2.3 MATERIALS

- A. Sheet Steel: ASTM A1011 Grade 36.
- B. Welding Materials: AWS D1.1, type as required for materials being welded.

2.4 FABRICATION

- A. Grating Type: NAAMM MBG 531, welded type.
- B. Fabricate framing for openings.
- C. Top Surface: Plain.
- D. Bearing Bar: 1-1/2-inch by 3/16-inch size, spaced 1-3/16-inch o.c.
- E. Crossbar: 3/16-inch by 3/16-inch size, spaced 4 inches o.c.

2.5 FINISHES

- A. Galvanizing: ASTM A123; hot-dip galvanize after fabrication.

2.6 ACCESSORIES

- A. Fasteners and Saddle Clips or J-hooks: Galvanized steel.
- B. Perimeter Closure: Same material as grating.
- C. Edge Banding: 3/1-inch at edges and at intermediate panel edges.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that opening sizes and dimensional tolerances are acceptable.
- C. Verify that supports are correctly positioned.

3.2 INSTALLATION

- A. Place frames in correct position, plumb and level.
- B. Mechanically cut galvanized finish surfaces only as approved by the Engineer. Do not flame cut.
- C. Anchor by bolting through saddle clips or J-hooks.
- D. Set perimeter closure flush with top of grating and surrounding construction.
- E. Secure to prevent movement.

3.3 TOLERANCES

- A. Conform to NAAMM MBG 531.

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 96 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 Engineer'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 manufacturer's 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 Engineer and the Manufacturer.

- F. Test Panel Requirements:
1. Size: Minimum four feet by four feet each.
 2. Locations: As determined by the Engineer.
 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:
1. Blok-Guard & Graffiti Control VOC 9

2.2 WATER REPELLENTS

- A. 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).

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 Owner to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Owners approves test application or as otherwise directed.
 - 1. Revisions of planned application, if any, as requested by Owner, 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 41 10 METAL ROOF PANELS

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 the following:
 - 1. Factory-formed and field-assembled, standing-seam metal roof panels.
 - 2. Metal soffit panels.
- B. Related Sections include the following:
 - 1. Section 07 62 10– Sheet Metal Flashing and Trim for flashings and other sheet metal work not part of metal roof panel assemblies.
 - 2. Section 07 92 00 – Joint Sealants – Architectural for field-applied sealants not otherwise specified in this Section.

1.3 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.

1.4 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/foot² of roof area when tested according to ASTM International (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. FM Global (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°F (67°C), ambient; 180°F (100°C), material surfaces.

1.5 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.
- 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.

1.6 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 Section 01 60 00 – Product Requirements.
1. Do not modify intended aesthetic effects, as judged solely by Engineer/Owner, except with Engineer's/Owner's approval. If modifications are proposed, submit comprehensive explanatory data to Engineer/Owner 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, Engineer, 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.

1.7 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.

1.8 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.

1.9 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.

1.11 FM GLOBAL REQUIREMENTS

- A. Use only FMG Approved construction materials on this project. Installed in accordance with the FMG product approval listing. Submit product data sheets for all materials used in this project. Refer to FM Global Approval Guide. <https://www.approvalguide.com/>

PART 2 PRODUCTS

2.1 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.

2.2 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.
 - i. 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 American Architectural Manufacturers Association (AAMA) 2605, except as modified below:
 - a) Humidity Resistance: 2,000 hours.
 - b) Water Resistance: 2,000 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.

2.3 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.

2.4 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 pounds/100 foot², rosin sized.
- D. Vapor barrier (Carlisle CCW705 or approved equal.).

2.5 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 ethylene propylene diene monomer (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.

2.6 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-inch 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 Owner 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.

2.7 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 Owner 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.

2.8 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 Sheet Metal and Air Conditioning Contractors' National Association's (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 Utah. Clamp to seam snow fence. Or approved equal. Color to match roof.
 - i. Berger Bros. Co.
 - ii. Polar Blox.

- F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.9 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 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, 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.

3.2 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 Section 07 62 00 – 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.

3.3 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 Section 07 21 00 – 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.

3.4 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 two inches.
1. Apply on roof not covered by self-adhering sheet underlayment. Lap edges of self-adhering sheet underlayment not less than three 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 six 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 Section 07 62 00 – Sheet Metal Flashing and Trim.
- D. Apply slip sheet over underlayment before installing metal roof panels.

3.5 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. Pre-drill 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 Section 07 92 00 – Joint Sealants – Architectural.

3.6 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.

3.7 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- 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 one 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 four 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 one 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. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.8 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.

3.9 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 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 Engineer.
 2. Notify Engineer 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 Engineer'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, 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

- A. Select an FM Approved perimeter flashing. See FM Global Property Loss Prevention Data Sheet 1-49, Perimeter Flashing. FM Approved perimeter flashing can be found in RoofNav (www.roofnav.com). On the Product Search Page, select "Flashing" for the Ca

tegory and "Perimeter Flashing" for the Subcategory. Specify any other criteria as needed and then click Search.

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 owner 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 square feet (0.16 kg/m²).

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.

END OF SECTION

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SECTION 07 92 00 JOINT SEALANTS – ARCHITECTURAL

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 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. Section 04 30 00 – Reinforced Unit Masonry for masonry control and expansion joint fillers and gaskets.

1.3 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.

1.4 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.

1.5 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 International (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 Engineer.
 - 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 Engineer 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.

1.6 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°F (5°C).
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 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

2.1 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.

2.2 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 Owner from manufacturer's full range.

2.3 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.

2.4 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.

2.5 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.

2.6 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.

2.7 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.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. 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.

3.4 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.

3.5 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.

3.6 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner 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 Owner from manufacturer's full range.

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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 and 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.

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SECTION 09 96 00 PROTECTIVE COATING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The Contractor shall provide protective coatings, complete and in place, in accordance with the Contract Documents.

- B. Definitions
 - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means Dry Film Thickness.

- C. The following surfaces shall not be coated:
 - 1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.
 - 2. Stainless steel
 - 3. Machined surfaces
 - 4. Grease fittings
 - 5. Glass
 - 6. Equipment nameplates
 - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

- D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

1.2 Contractor SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating WORK:
 - 1. Materials List: A copy of a coating materials list showing the manufacturer and the product number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submitting samples.
 - 2. Manufacturer's Information: For each coating system to be used, the following data:
 - a. Manufacturer's data sheet for each proposed product
 - b. Manufacturer's statements on the suitability of the proposed products for the intended use. Include in the statement confirmation that the coating manufacturer's technical engineering representative inspected all existing substrate and/or surfaces with existing coatings and confirmed that the proposed products, application procedures and surface preparation requirements are compatible with the coatings required by this Section.
 - c. Technical and performance information that demonstrates compliance with the system performance and material requirements.
 - d. Paint manufacturer's instructions and recommendations on surface preparation and application.
 - e. Colors available for each product (where applicable).
 - f. Compatibility of shop and field applied coatings (where applicable).
 - g. Safety Data Sheet for each product proposed.
- C. Samples
 - 1. Samples of paint, finishes, and other coating materials shall be submitted on 8-1/2 inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.
 - 2. Two sets of color samples to match each color selected by the OWNER from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the OWNER or ENGINEER.

3. One 5 pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

D. Experience Requirements of the Field Applicator:

1. Submit a project organization chart showing the full name and clear lines of responsibility and duties for all personnel scheduled to perform work (including office managers, quality control supervisor and safety supervisor) on the project.
2. Submit for documentation a statement on company letter head indicating the name of the Quality Control Supervisor (QCS) who has been given written authority by executive management to perform the duties of the QCS position for the project. Include in the statement the date of last successful completion of training to perform the QCS position. Acceptable coating inspection training programs include at a minimum: SSPC (PCI, NBPI, BCI) Level 1, KTA Level 1, GPI (Level 1), NACE (CIP Level 1, Frosio) or equivalent formal in-house inspection training conforming to ASTM D3276.
3. Submit for documentation the set of procedures that have been implemented for conducting and documenting training (as needed) and for qualifying trainees, newly hired craft workers and newly hired experienced workers. Include documentation of annual proficiency evaluation system for all craft workers.
4. Submit for documentation up-to-date experience, training certificates, and licenses for all personnel scheduled to perform work on the project.
5. Submit for documentation a statement on company letter head that key personnel (including but not limited to, project management and QCS) have reviewed the project contract documents and specifications in effect at contract award. Include in the statement confirmation that the project contract documents and specifications have been distributed to all affected personnel within the organization scheduled to perform work on the project. Include in the statement the procedure for recording receipt and distribution of specifications and contract documents and all changes and revisions to contract documents. Include in the statement the procedures for documenting verbal responses from the Owner for requests for clarification.
6. Submit references of successfully completed projects for industrial coating projects completed within the last 18 calendar months. Acceptable references shall include contact information for owner staff having direct connection with the project, copies of facility owner project performance evaluations, letters of commendation from the owner or prime contractor, statements of final payment, and punch list acceptance.

E. Quality Assurance Plan

1. Submit for review the written project-specific Quality Control Program to be followed. Primary duties and responsibilities of the QCS as outlined in the Quality Control Program shall include but are not limited to the following:
 - a. Ensuring that qualified personnel perform the WORK on the project.
 - b. Ensure that proper inspection forms and recording procedures are used for job quality monitoring (including those required herein).
 - c. Ensure correct and properly operating and calibrated equipment is used.
 - d. Review and sign off on Daily Inspection Reports (DIRs) on a timely basis (QCS must sign off or authorize review of DIRs by other competent QC personnel).
 - e. Ensure that WORK is inspected for conformance with the contract requirements, good painting practice, and internal QC procedures.
 - f. Ensure that nonconforming work and rework is properly documented.
 - g. Develop and/or review Inspection and Test Plans.
 - h. Conduct and/or review internal audits.
2. Submit for documentation written project-specific procedures for all production processes to be used on the project. The procedures shall include, but are not limited to the following:
 - a. Standard company or contract specific procedures are available to and used by on-site personnel for verifying that coating and related operations are performed in accordance with contract requirements and industry best practices.
 - b. Inspection procedures or project specific inspection plans ensuring that all work is properly performed and documented on a daily basis during coating operations or documented in accordance with contract requirements, are available to site personnel, and are used to perform in-process inspections of work at key hold points.
 - c. Abrasive blasting (dry or wet) and related processes
 - d. Water jetting and related processes
 - e. Hand and power tool cleaning and related processes
 - f. Coating mixing and related processes

- g. Coating application (e.g. brush, roller, spray, mit) and related processes
 - h. Topcoating procedures (e.g. conditions when meeting and exceeding recoat windows)
 - i. Curing process for materials applied
 - j. Erecting, moving and tearing down containment
 - k. Field audits performed on site confirming equipment is in good operating condition
3. Submit for review and documentation Daily Inspection Reports (DIRs) to Engineer on a weekly basis. All DIRs and testing results shall be maintained on file for the duration of the project. DIRs must be signed and dated by the Contractor and formally reviewed by the QCS. DIRs and other daily reports shall record project relevant observations including:
- a. Compressed air cleanliness
 - b. Air temperature (dry and wet bulb)
 - c. Relative humidity
 - d. Dew point
 - e. Substrate surface temperature
 - f. Abrasive cleanliness
 - g. Surface preparation cleanliness specified and achieved
 - h. Surface profile specified and achieved
 - i. Illumination of work area (foot candles for surface preparation, coating application, and inspection) in accordance with SSPC Technology Guide 12 recommendations or contract requirements.
 - j. Batch numbers of coatings and thinners. Include product name/number of thinner and quantity (volume) of thinner used.
 - k. Mixing of coatings (in accordance with coating manufacturer's mixing instructions)
 - l. DFT readings for each applied coating meeting specification requirements.
 - m. Inspection instruments used (manufacturer, model, and serial number)
 - n. Storage temperature and storage conditions to include min/max daily, or as required.

1.3 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

- A. Nonconforming work, identified by Contractor QC personnel, Owner, Engineer or Owner's Representative performing QA on behalf of the Owner shall be documented and repaired.
- B. Inspection: An inspection may be conducted during the eleventh month following completion of coating WORK. The Contractor and a representative of the coating material manufacturer shall attend this inspection. Defective WORK shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the Contractor, reschedule the inspection to another date within the one year correction period or may cancel the inspection altogether. The Contractor is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

1.4 COMPLIANCE WITH VOLATILE ORGANIC COMPOUND (VOC) LIMITS

- A. All paint and coating products shall comply with the applicable limits on volatile organic compounds (VOCs) as established by the United States Environmental Protection Agency and by state and local air quality regulating agencies. It shall be the Contractor's responsibility to verify compliance of all paints and coatings.
- B. Listed products in this specification are based on a maximum VOC level of 250 g/L. If local limits on VOCs are higher or lower, the Contractor shall propose substitute products that are compliant with local limits and equivalent in performance to the listed product. The ENGINEER shall determine if the proposed product is equivalent or equal to the named product in accordance with the requirements of Section 01 60 00 - Product Requirements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Suitability: The Contractor shall use suitable coating materials as recommended by the manufacturer.
- B. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the Contractor shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

- C. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.
- E. Colors: Colors and shades of colors of coatings shall be as indicated or selected by the Owner. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the Owner.
- F. Substitute or "Or-Equal" Products
 - 1. To establish equality under Section 01 60 00 - Product Requirements, the Contractor shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:
 - a. Suitability for the intended service
 - b. Compatibility with other coatings
 - c. Resistance to chemical attack
 - d. Minimum and maximum recoat times
 - e. Minimum and maximum cure time for immersion
 - f. Abrasion resistance per ASTM D4060 using CS17 Wheel
 - g. Maximum and minimum dry film thickness per coat
 - h. Temperature limitations during application and in service
 - 2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the Contractor shall provide the ENGINEER with the names of not less than 10 successful applications and case histories of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the WORK, the Contractor shall bear such costs involved as part of the WORK.

2.2 INDUSTRIAL COATING SYSTEMS

A. System 1 - Acrylic Polymer

1. Materials

Primer	Manufacturer's recommendation
Finish Coat	1 component water based acrylic
Type	Pure acrylic emulsion
Demonstrated suitable for	Ferrous and nonferrous surfaces, and PVC pipe in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance.
VOC Content, max (g/L)	250

2. Application and manufacturers

Prime Coat (DFT = 2 to 4 mils)	Finish Coat (DFT = 2 to 4 mils)	Total System DFT
PPG Pit Tech	PPG Pit Tech	
Tnemec Series 115 Unibond	Tnemec Series 1029 Enduratone for Semi-Gloss finish (use Series 1028 for Gloss finish)	
Carboline Rust Bond	Carbocrylic 3359 Series	4 to 8 mils
Sherwin Williams Procryl Primer	Sherwin Williams Pro Industrial Acrylic	

B. System 2 - Organic Zinc/Epoxy/Polysiloxane

1. Materials

Primer	Organic Zinc
Intermediate coat	Epoxy
Finish Coat	
Type	Polysiloxane
Demonstrated suitable for	Long Term Outdoor Exposure and Color Retention
VOC Content, max	250 Grams Per Liter

2. Application and manufacturers

Prime Coat (DFT = 3 to 5 mils)	Intermediate Coat (DFT = 4 to 8 mils)	Finish Coat (DFT = 4 to 6 mils)	Total Min DFT
Sherwin Williams Corothane Galvapak 2K 100 MCU Zinc	S-W Macropoxy 646- 100 B58 Series	Sherloxane 800	11 mils
PPG Amercoat 68HS	PPG PSX 700		
Carboline Carbozinc 859	Carboline Carboguard 890 Series	Carboline Carboxane 2000	
Tnemec Series 94 H2O Hydro-Zinc	Tnemec Series L69 Hi-Build Epoxoline II	Tnemec Series 690 Polysiloxane	

C. System 3 - Not Used

D. System 4 - Epoxy/Polyurethane

1. Materials

Primer type	2 Component Epoxy
VOC Content, max (g/L)	250
Finish type	2 Component Aliphatic Polyurethane
VOC Content, max (g/L)	250
Demonstrated suitable for	Ferrous Surfaces, Superior Color and Gloss Retention, Exceptional Resistance to Weathering, Chemical Fumes, and Splash.

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	Finish Coat (DFT = 3 - 4 mils)	TOTAL SYSTEM DFT
Carboline Carboguard 890	Carboline Carbothane 134 VOC	
Devoe Devran 224V	Devoe 379H	
Tnemec Hi-Build Epoxoline II Series L69	Tnemec Endura-Shield Series 1095 for Semi-Gloss finish (use Series 1094 for Gloss finish)	6 - 9 MILS
PPG Amerlock 400/2	Amershield VOC	
Sherwin Williams Macropoxy 646	Sherwin Williams Hi-Solids Polyurethane	

E. System 5 - Inorganic Zinc/Epoxy/Polyurethane

1. Materials

Prime Coat	Inorganic Zinc Silicate, Water-Based, 2 Component
zinc content in dry film	79 Percent, Minimum
VOC content, max (g/L)	0
Demonstrated suitable for	Ferrous Metal, Providing Superior Corrosion, Chemical, and Abrasion Resistance, Recommended for Use as Primer Under Epoxy
Intermediate Coat	2 Component Epoxy, High Build, Recommended By Manufacturer For Application Over Inorganic Zinc Primer
Demonstrated suitable for	Outstanding Chemical, Corrosion, and Abrasion Resistance
VOC content, max (g/L)	250
Finish Coat	2 Component Aliphatic or Acrylic Polyurethane
Demonstrated suitable for	Superior Color and Gloss Retention, Resistance to Chemical Fumes, Severe Weathering, and Abrasion
VOC content, max (g/L)	250

2. Application and manufacturers

Surface preparation for primer	SSPC SP 10
Anchor profile for primer	per manufacturer

Prime Coat (DFT = 3 - 4 mils)	Intermediate Coat (DFT = 4 - 6 mils)	Finish Coat (DFT = 3 - 4 mils)	Total System DFT
PPG- Dimetcote 21-5	Amerlock 2/400 VOC	Amershield VOC	
Carboline Carbozinc 11WB	Carboguard 893	Carbothane 134VOC	
Tnemec Tneme-Zinc 94H20	Tnemec Series L69	Tnemec Series 1095	10 - 14 mils
Sherwin Williams Zinc Clad XI	S W Macropoxy 646	S-W Hi-Solids Polyurethane 250	
Devoe Cathacote 305	Devoe Devran 224V	Devoe Devthane 379H	

F. System 6 - Inorganic Zinc, Water Based

1. Material

Type	Water Based Zinc Silicate, 2 Component
Percent Zinc in dry film	83, Min
VOC Content, max (g/L)	0
Demonstrated suitable for	Severe Weathering and Moderate Chemical Fumes, Continuous Temperatures of 750°F

2. Application and manufacturers

Product (single coat)	Total System DFT
PPG- Dimetcote 21-5	
Devoe Cathacoat 305	
Carboline Carbozinc 11 WB	4 - 8 mils
Sherwin Williams Zinc Clad XI	

G. System 6A - Epoxy, High Heat under Thermal Insulation Wrap

1. Material

Type	Epoxy, High Heat Under Thermal Insulation Wrap
VOC Content, max (g/L)	250
Demonstrated suitable for	Protection of Iron and Steel Surfaces That May Experience Elevated Temperatures Up to 600°F Under Thermal Insulation Wrap; Do Not Use For Atmospheric Exposed Conditions; Do Not Use For Stainless Steel.

2. Application and manufacturers

Product (2 coats at 2 - 4 mils each)	Total System DFT
PPG Amercoat 91 with Amercoat 880 glass flake additive	4 - 8 mils
Sherwin Williams EpoPhen	
Carboline Thermaline 450	

H. System 8 - Epoxy, Equipment

1. Materials

Primer Type	2 Component Epoxy
Demonstrated suitable for	Rust Inhibitive, Outstanding Chemical, Abrasion, and Weathering Resistance, Resistance to Splash, Washdown, and Condensation. Immersion Capability is Not Required
VOC content, max (g/L)	250
Finish Type	2 Component Epoxy, Available in Many Colors
Demonstrated suitable for	Outstanding Chemical, Abrasion, and Weathering Resistance, Resistance to Splash, Washdown, and Condensation. Immersion Capability is Not Required
VOC content, max (g/L)	250

2. Application and manufacturers

Prime Coat (DFT = 4 - 5 mils)	Finish Coat (DFT = 4 - 5 MILS)	Total System DFT
Devoe Bar-Rust 231	Devoe 224V	8 - 10 mils
PPG- Amerlock 2/400 VOC	Amerlock 2/400 VOC	
Tnemec Series L69	Tnemec Series L69	
Carboguard 60	Carboguard 60	
Sherwin Williams Macropoxy 646	Sherwin Williams Macropoxy 646	

- I. System 9 - Not Used
- J. System 10 - Not Used
- K. System 11 - Not Used
- L. System 12 - Polyurethane, Fiber Glass

1. Materials

Primer Type	As Recommended by Manufacturer
Finish Type	2 Component Aliphatic Polyurethane
Demonstrated suitable for	Fiberglass, Superior Color and Gloss Retention, Resistance to Acid and Alkali Splash, Fumes, and Severe Weathering, No Immersion
VOC content, max (g/L)	250

2. Application

Prime Coat (3 to 4 mils)	Finish Coats (4 to 6 mils)	TOTAL SYSTEM DFT
Devoe Bar-Rust 231	DEVTHANE 379H (2 coats)	
Carboline Carbocrylic 120 (2 coats)	Carbothane 134 VOC (2 coats)	
PPG Amerlock 2/400 VOC	Amershield VOC	7 to 10 mils
Tnemec Epoxoline Series L69	Tnemec Series 1095 Endura-Shield	
Sherwin Williams Macropoxy 646	S-W Hi-Solids Polyurethane 250	

2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. System 100 - Amine Cured Epoxy

1. Material

Type	High Build, Amine Cure Epoxy
VOC content, max (g/L)	250
Demonstrated suitable for	Steel, Long Term Immersion in Wastewater, Resistant to Corrosion, Chemical Fumes, Good Color Retention

2. Application and manufacturers

Products (3 coats or more)	Total System DFT
PPG- Amercoat 240	15 to 17 mils
Carboline Carboguard 891HS	For non-submerged valves and other equipment, DFT = 10 to 12 mils
Tnemec Epoxoline Series L69	
Sherwin Williams Tank Clad HS	

B. System 101 - (Not used)

C. System 102 - Polyamide Epoxy

1. Materials

Type	High Build Polyamide Cure Epoxy
VOC content, max (g/L)	250
Demonstrated suitable for	Long Term Immersion in Water, Resistant to Corrosion and Chemical Fumes, Good Color Retention
Certification	NSF 61/600 If in Contact with Potable Water

2. Application and manufacturers

Products (3 coats or more)	Total System DFT
Devoe Bar-Rust 233H	12 - 18 mils
Tnemec Epoxoline Series 21	
PPG- Amerlock 2/400 VOC	
Carboguard 61	
Sherwin Williams Macropoxy 646 PW	

D. System 103 - Not Used

E. System 104 - Not Used

F. System 105 - Not Used

G. System 106 - Fusion Bonded Epoxy

1. Material

Type	100 Percent Solids Fusion Bond Epoxy
Demonstrated suitable for	Fluidized Bed or Electrostatic Spray Application, Recommended for Pumps, Valves, Pipe Appurtenances, Tanks, Pipe Hangers, Flow Meters, and Hydrants
Certification requirement	NSF 61

2. Application in accordance with AWWA C213 and the following:

Product	Surface and DFT
3M Scotchkote 134 or 206N	Valves 12-mils
	All others 16-mils

H. System 107 - Chemical Resistant Sheet Lining:

1. Materials: The Contractor shall use natural rubber, chlorobutyl rubber, ethylene propylene diene monomer (EPDM) rubber, chloroprene polymer (neoprene) rubber, or chlorosulfonated polyethylene (Hypalon) rubber sheet lining materials as indicated. The Shop Drawing submittal shall contain technical information that confirms the suitability of the lining material system for long-term immersion in each chemical to be stored. The service temperatures are expected to be up to 150 degrees F.
2. Neoprene sheet lining material shall be synthetic rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16 - inch. The lining material shall be **Polymeric Protective Linings BFG 2011 (59688)**, or equal.
3. Chlorobutyl sheet lining material shall be synthetic rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16-inch. The lining material shall be **Polymeric BFG 1051 (60924)**, or equal.
4. Natural rubber (soft) sheet lining material shall be soft natural rubber formulated for steam curing at atmospheric pressure. The minimum lining thickness shall be 3/16-inch. The lining material shall be **Polymeric BFG 2004 (83160)**, or equal.
5. Natural rubber (hard) sheet lining material shall be a hard, natural rubber resistant to oxidizing agents and formulated for autoclave curing. The minimum lining thickness shall be 3/16-inch. The lining material shall be **Polymeric BFG 1006 (8631)**, or equal.
6. EPDM sheet lining material shall be synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution and formulated for autoclave or steam curing under pressure. The lining material shall be **Polymeric BFG 1039 (EP156)**, or equal.
7. Hypalon sheet lining material shall be synthetic rubber suitable for use as a lining for 50 percent sulfuric acid solution. The lining material shall be **Polymeric BFG 2045 (8706)**, or equal.
8. Primers, adhesives, activators, accelerators and other necessary materials shall be as required by the sheet material manufacturer.

9. Metal Surface Preparation: Prior to abrasive blast cleaning the base metal shall be prepared as required by the sheet lining material manufacturer's installation instructions. If the instructions differ from these specifications, the highest degree of cleaning and surface preparation shall be provided. Abrasive blast cleaning shall be done in accordance with this Section.
 10. Installation of lining materials shall be in accordance with the material manufacturer's written installation instructions. All interior surfaces shall be lined, including all piping, vents, fittings, flange faces, manhole covers, and blind flanges.
 11. The lining system shall be holiday tested in accordance with this Section before and after curing.
 12. The lining system shall be cured by steam using the time and temperature as required by the material manufacturer.
- I. System 108 - Polyurethane, Concrete

1. Materials

Filler-sealer type	Epoxy Material with Portland Cement and Aggregate
Primer type	Phenolicamine or Polyamidoamine Epoxy
VOC content, max (g/L)	250
Finish type	Aromatic Elastomeric Polyurethane
Demonstrated suitable for	Concrete and Concrete Block Masonry, Long Term Immersion in Water and Wastewater and Service Where Subject to Splash and Spill of Water and Wastewater Treatment Chemicals
VOC content, max (g/L)	250

2. Application and manufacturers

Filler-Sealer	Primer	Finish Coat
	DFT = 3 - 7-mils	DFT = 100 - 125-mils
Tnemec MortarClad 218	Epoxoprime 201	Elasto-Shield 406
PPG-Amercoat 100A	Amerlock 2/400	Amerthane 490
Sherwin Williams Steel Seam FT 910	S-W Dura-Plate 235	S-W Sherflex (Max 100 mils for potable water)

J. System 109 - Epoxy, Concrete

1. Materials

Filler-sealer type	Epoxy Material with Portland Cement and Aggregate
Primer type	100% Solids Epoxy
VOC content, max (g/L)	450
Finish type	Amine Cure Epoxy/Aggregate-Filled Epoxy
Demonstrated suitable for	Sewer Manhole & Wastewater Facility, Long Term Immersion in Wastewater Service Where Subject to Chemical and Bacteriological Attack Found in Municipal Sanitary Sewer System
VOC content, max (g/L)	450

2. Application and manufacturers

Filler-Sealer	Primer	Finish Coat
	DFT = 5 – 10 mils	DFT = 125 – 150 mils
PPG Raven 210	PPG Raven 155	PPG Raven 405 FS
Sauereisen Filler Compound 209 or 209FS	Per Sauereisen	SewerGard 210
Sherwin Williams Duraplate 2300	Sherwin Williams Macropoxy 5000	Sherwin Williams Duraplate 6000, 6100
		Warren Environmental
Epoxytec Mortartec Ceramico	Per Tnemec	Epoxytec CPP Sprayliner MH

K. System 110 - Not Used

L. System 111 - Vinyl Ester, Concrete

1. Topcoat Material

Type	Vinyl Ester, with Aggregate or Flake Fill
Demonstrated suitable for	72 Hour Immersion in 30 Percent Sulfuric or Hydrochloric Acid, Sodium Hydroxide, Sodium Hypochlorite, Alum, Aqueous Ammonia, Ferric Chloride, Hydrogen Peroxide, Sodium Chloride, Cationic or Anionic Polymer

2. Application and manufacturers

Filler-Sealer	Primer	Finish Coat
1/16-inch	DFT = mils	DFT = -mils
PPG Milamar 600	PPG Milamar Ultraprime (3 mils DFT)	PPG Milamar 6850 CS - 3 coats (11-14 mils each)
Tnemec MortarClad 218	Vinester Series 1407 5-6 mils	Vinester Series 1416 20-30 mils
Sherwin Williams Corobond VE Primer	S-W Cor Cote VEN FF or GF	S-W Cor Cote VEN FF or GF
Carboguard 510 or 510SG	Semstone 800, 8 - 10 mils	Semstone 870, 30 mils
International Ceilcote 380M Primer 4-5 mils	International Ceilcote 242 Flakeline, 1 coat 15-25 mils	International Ceilcote 242 Flakeline, 1 coat 15-25 mils

2.4 SPECIAL COATING SYSTEMS

- A. **System 200 - PVC Tape:** Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils.
- B. **System 201 - Rich Portland Cement Mortar:** Rich portland cement mortar coating shall have a minimum thickness of 1/8-inch, followed by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped and sealed with tape.
- C. System 202 - (Not used)
- D. System 203 - Epoxy Surfacing on Concrete Floors

1. Material

Type	2 Component Epoxy Floor Surfacing
Demonstrated suitable for	Concrete, Resistance to Abrasion and Many Acids And Alkalis Such as Liquid Alum, Sodium Hydroxide, and Sulfuric Acid
VOC Content, max (g/L)	250

2. Application and manufacturers

Primer/Sealer	Finish Coat (1/4-inch thick)
PPG Flooring - Concrete Epoxy Primer	PPG Flooring - Self Leveling Epoxy
Tnemec Power-Tread 237	Tnemec Power-Tread 237
Carboline Semstone 110	Carboline Semstone 145 SL
International Ceilcote 680(M)*	International Ceilcote 625 Ceilflor Series
Sherwin Williams General Polymers TPM 12	S-W General Polymers TPM 12

E. System 204 - Water Retardant, Concrete

Type	Silane-Modified Siloxane
Demonstrated suitable for	Repelling Water from Vertical Concrete and Masonry Surfaces
VOC Content, max (g/L)	250
Products, or equal	Sherwin Williams H&C Super V (315 G/L) Or Loxon 7% Siloxane Water Repellent (0 VOC) Tnemec Series 633 Prime A Pell H2o

F. **System 205 - Polyethylene Encasement:** Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

G. **System 206 - Cement Mortar Coating:** A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane Forming Compounds for Curing Concrete," ASTM C 309, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all edges and joints lapped by at least 6-inches.

H. System 207 - Not Used

I. System 208 - Aluminum Metal Isolation

1. Material

Type	High Build Polyamide Epoxy with Chemical and Abrasion Resistance
Demonstrated suitable for	Concrete And Aluminum Substrates, to Isolate Aluminum from Contact with Concrete and the Resulting Chemical Degradation
VOC content, max (g/L)	250

2. Application and manufacturers

Coating

(DFT = 16 - 20 mils)

PPG- Amercoat 240

Sherwin Williams Macropoxy 646

Tnemec Epoxoline Series L69

Carboline 890

Devoe Bar-Rust 231

J. System 209 - Not Used

K. System 210 - Not Used

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

- A. The Contractor shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.
- B. 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 at least 8 hours of on-Site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.2 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on coating WORK.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. Damage to other surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations: Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.
- B. Coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

- A. General: Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The Contractor shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.
- B. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

- C. Hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent WORK during blasting operations. Spraying shall be conducted under carefully controlled conditions. The Contractor shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.
- E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces.

3.5 ENVIRONMENTAL REQUIREMENTS

- A. No coating work shall be performed under the following conditions:
 - 1. Surface or ambient temperatures exceed the manufacturer's recommended maximum or minimum allowable.
 - 2. Dust or smoke laden atmosphere.
 - 3. Damp or humid conditions, where the relative humidity is above the manufacturer's maximum allowable.
 - 4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.
 - 5. Ambient temperature that is expected to drop below 50°F or less than 5°F above the dew point within 8 hours after application of coating.

3.6 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:
 - 1. Solvent Cleaning (SSPC SP 1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC SP 2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
3. Power Tool Cleaning (SSPC SP 3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
4. White Metal Blast Cleaning (SSPC SP 5/NACE 1): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
5. Commercial Blast Cleaning (SSPC SP 6/NACE 3): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. Brush-Off Blast Cleaning (SSPC SP 7/NACE 4): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
7. Near-White Blast Cleaning (SSPC SP 10/NACE 2): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. Power Tool Cleaning to Bare Metal (SSPC 11) When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. The surface profile shall not be less than 1 mil (25 microns).
9. Surface Preparation of Concrete (SSPC-SP 13/NACE 6): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.7 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. The Shop Painting Facility shall use a minimum blast material mixture of 75% grit and 25% shot material to achieve the proper surface profile.

- C. The Field Coating Applicator shall abrasive blast the shop coated surfaces per SSPC SP 7/NACE 4. The previously shop-painted surfaces shall be abraded prior to the application of the final coats. Special attention shall be given to uncoated steel weld joints, coating holdbacks, and bare metal.
- D. Grease, oil, and welding fluxes shall be removed by wiping with MEK or naphtha cleaning or with trisodium phosphate detergent per SSPC SP 1.
- E. All sharp edges shall be rounded or chamfered and all burrs, rust, scale, welding slag, and spatter shall be removed and the surface prepared by SSPC SP 2 hand tool cleaning, and SSPC SP 3 power tool cleaning.
- F. The Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any blasted surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter ($\mu\text{g}/\text{cm}^2$). A test shall be conducted for every 100 square feet (ft^2) of surface area to be coated at locations determined by the Inspector.
- G. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate's surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.
- H. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions. Abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent new grit.
- I. The Contractor shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
- J. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.
- K. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.
- L. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.

- M. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.
- N. If the required abrasive blast cleaning will damage adjacent WORK, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP 2 or SSPC SP 3 may be used.
- O. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP 1 before the abrasive blast cleaning has been started.
- P. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

3.8 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP 1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP 7/NACE 4.
- B. Any high spots, sharp protrusions, and rough edges, such as the metal drip line, shall be smoothed to avoid paint film gaps in the areas of the high spots. Surfaces shall be hand tool cleaned per SSPC SP 2 and power tool cleaned per SSPC SP 3.
- C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.
- D. The surfaces of galvanized steel exposed to chemical splashing or within a wastewater head space shall be abraded per SSPC SP 11 or SP 7 prior to coating.

3.9 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

- A. General: Grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.
- B. Abrasive Blast Cleaning: The Contractor shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP 6/NACE 3. Areas of tightly adhering coatings shall be cleaned to SSPC SP 7/NACE 4, with the remaining thickness of existing coating not to exceed 3-mils.

- C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings the Contractor shall apply intermediate coatings per the manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.
- D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.
- E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged or severe service coating systems unless indicated.

3.10 CONCRETE AND CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. Surface preparation shall not begin until at least 30 Days after the concrete or masonry has been placed.
- B. At the discretion of the Inspector, the Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter ($\mu\text{g}/\text{cm}^2$). A test shall be conducted for every 100 square feet (ft^2) of surface area to be coated at locations determined by the Inspector.
- C. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate's surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.
- D. In accordance with ASTM D4262, test to determine the pH of the concrete surface after the surface has been thoroughly blasted and cleaned. If the pH is outside the range recommended by the coating manufacturer, then the surface must be neutralized by removing concrete until the surface pH of 7 or greater is obtained prior to any coating application. One pH test shall be performed every 200 square feet, or less, and at locations determined by the Inspector.

- E. The Contractor shall test for capillary moisture in accordance with ASTM D4263. Moisture tests shall be taken every 200 square feet or less and at locations determined by the Inspector. If capillary moisture is present, the coating manufacturer shall be consulted to determine primer requirements and special coating application criteria.
- F. For below grade structures with surface areas greater than 2,000 square feet, the Contractor shall install three anhydrous calcium chloride test kits on bare concrete to measure the Moisture Vapor Transmission Rate (MVTR) on a flat horizontal surface. Testing and calculations shall be performed according to ASTM F1869. The MVTR shall be less than 3 lbs per 1,000 square feet per 24 hours. If the MVTR is greater than 3 lbs per 1,000 square feet per 24 hours, the Contractor shall apply a concrete sealant to reduce the MVTR through the concrete. The test kits shall be undisturbed for a minimum of 60 hours.
- G. Surface Voids: Bugholes, honeycomb, or other surface voids greater than 1/4 inch in depth or 1/4 inch in diameter shall be filled in with a resurfacing mortar prior to the application of any primer or finish coat.
- H. Holes or other joint defects in masonry shall be filled with mortar and repainted. All voids and cracks shall be repaired as specified. Loose or spatter mortar shall be removed by scraping and chipping. Masonry surfaces shall be cleaned with clear water by washing and scrubbing to remove foreign and deleterious substances. Muriatic acid shall not be used. After cleaning, masonry surfaces shall be sealed or filled with a sealer or block filler compatible with the specified primer.
- I. Coating Pipe Penetrations: A 1/4-inch wide by 3/8-inch deep saw cut shall be made around the circumference of the pipe as it penetrates the concrete. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.
- J. Coating Floor/Wall Joints: A 1/4-inch wide by 3/8-inch deep saw cut shall be made on the vertical and horizontal concrete surfaces around the perimeter of the floor. The saw cut shall be 2 inches from the joint on both sides. Prior to the coating application, the saw cut shall be dried and vacuumed to remove all dust and residue.
- K. All oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC-SP 1 before abrasive blast cleaning.
- L. New concrete, concrete block masonry surfaces and deteriorated concrete surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, and deteriorated concrete, and to roughen the surface equivalent to 80 Grit sandpaper or ICRI No. 310.2 Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays Concrete Surface Profile No. 4.

- M. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.

3.11 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

- A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.
- B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC SP 1 followed by sanding or brush-off blast cleaning SSPC SP 7/NACE 4.
- C. Surfaces shall be clean and dry prior to coating application.

3.12 ARCHITECTURAL CONCRETE BLOCK MASONRY SURFACE PREPARATION

- A. The mortar surfaces shall be cured at least 14 Days before surface preparation WORK is started.
- B. Dust, dirt, grease, and other foreign matter shall be removed prior to abrasive blasting.
- C. The masonry surfaces shall be prepared in accordance with the material manufacturer's printed instructions.

3.13 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish-coated in the shop and then be touched up after installation.
- B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.
- C. Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning all surfaces as necessary in accordance with SSPC SP 1 and SP 2. Damaged shop coating shall be cleaned in accordance with SSPC SP 3, Power Tool Cleaning, and recoated with the primer specified.

- D. For every 500 square feet, or less, of steel surface blasted, the surface profile shall be tested with the use of Press-o-Film as manufactured by Testex, or other RP0287 approved equal, at locations to be determined by the Inspector. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex, or other ASTM D4417 Type C approved equal. For each test area, one replica tape test shall be performed. For each test area, the three replica tape thickness values shall be recorded and must be within 10% of the coating manufacturer's recommended profile. If the surface profile does not meet the manufacturer's recommended profile, two additional tests will be performed within a 12-inch diameter of the initial test. If the values are not satisfactory, the Contractor shall reblast the affected areas.
- E. The interior surfaces of steel water reservoirs, except for Paragraph A surfaces, shall have surface preparation and coating WORK performed in the field.
- F. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The Contractor shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.
- G. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- H. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top coated or less time if recommended by the coating manufacturer.
- I. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.
- J. The Contractor shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.14 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA1 - Paint Application Specification No. 1.
- B. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The Contractor shall schedule such inspection with the ENGINEER in advance.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Contractor shall use an independent stripe coat per SSPC PA Guide 11 for these areas. Particular care shall be used to ensure that the specified coverage is secured on the edges and corners of all surfaces.
- F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
- H. Coatings shall not be applied under the following conditions:
 - 1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.
 - 2. Concrete surfaces will be in direct sunlight during application or within 3 hours after application.
 - 3. Dust or smoke laden atmosphere.
 - 4. Damp or humid weather.
 - 5. Substrate or air temperature is less than 5 degrees F above the dew point.
 - 6. Air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.

7. Wind conditions are not calm.
- I. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychrometric tables.
- J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.
- K. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.15 CURING OF COATINGS

- A. The Contractor shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

3.16 IDENTIFICATION OF PIPING

- A. Identification of piping shall be in accordance with Section 40 06 00 - Pipe and Fittings.
- B. Every valve or connection, where it may be possible for a worker to be exposed to a hazardous substance, shall be labeled per OSHA Occupational Safety and Health Standards 29CFR1910.1200.
- C. Unburied pipes in structures and in chemical pipe trenches shall be color-code painted. Colors shall be as selected by the Owner or as indicated.

3.17 SHOP AND FIELD INSPECTION AND TESTING

- A. General: The Contractor shall give the ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.
- B. Such WORK shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such WORK in its absence.
- C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the Contractor of its responsibility to perform the WORK in accordance with these Specifications.

- D. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.
- E. Inspection Devices: The Contractor shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for the ENGINEER's use while coating is being done, until final acceptance of such coatings. The Contractor shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the ENGINEER.
- F. Holiday Testing: The Contractor shall test for continuity all coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then be retested.
1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as **Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20**, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.
 2. Coatings with thickness of 20-mils or less total DFT: **Tinker & Razor Model M1** non-destructive type holiday detector, **K-D Bird Dog**, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo** or equal, shall be added to the water prior to wetting the detector sponge.
- G. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as **Mikrotest Model FM, Elcometer Model 111/1EZ**, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- H. Surface Preparation: Confirm proper surface profile with Testex Press-O-Film replica tape in accordance with NACE RP0287-02.

3.18 COATING SYSTEM SCHEDULE, FERROUS METAL – NOT GALVANIZED

Item	Surface Prep.	System No.
FM-1	Surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3 (1) acrylic polymer
FM-1	Surfaces of equipment and ferrous surfaces outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3 (4) epoxy/ polyurethane
FM-1	Surfaces of equipment and miscellaneous steel indoors and outdoors, exposed or covered, except those included below.	Near white metal blast cleaning SSPC SP 10/NACE 2 (5) inorganic zinc/epoxy/polyurethane
FM-2	Surfaces in chemical room.	Commercial blast cleaning SSPC SP 6/NACE 3 (100) amine cure epoxy
FM-3	Surfaces of equipment and ferrous surfaces submerged or intermittently submerged in utility water and wastewater including all surfaces lower than 2 feet above high water level in hydraulic structures, and all surfaces inside enclosed hydraulic structures and vents (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP 5/NACE 1 (100) amine cure epoxy
FM-4	Surfaces exposed to high temperature (between 150 and 600 degrees F).	Near white metal blast cleaning SSPC SP 10/NACE 2 (6) inorganic zinc, water-based
FM-6	Buried small steel pipe.	Removal of dirt, grease, oil (200) PVC tape
FM-7	Where indicated, ferrous surfaces in water passages of all valves 2-inch size and larger, exterior surfaces of submerged valves.	White metal blast cleaning SSPC SP 5/NACE 1 (102) polyamide epoxy
FM-8	Where indicated, ferrous surfaces in water passages and submerged surfaces of all pumps which have discharge size of 4 inches or larger.	White metal blast cleaning SSPC SP 5/NACE 1 (100) amine cure epoxy
FM-9	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP 1, followed by white metal blast cleaning SSPC-SP 10/NACE 2 (106) fusion bond epoxy
FM-10	All ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White metal blast cleaning SSPC SP 5/NACE 1 (102) polyamide epoxy
FM-11	Buried surfaces that are not indicated to be coated elsewhere.	Near white metal blast cleaning SSPC SP 10/NACE 2 (100) amine cure epoxy

FM-14	Structural steel, miscellaneous metalwork, and supports for prefabricated metal buildings.		
FM-15	Structural steel, miscellaneous metalwork, and supports for roof and face support systems for buildings.		
FM-16	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC SP 6/NACE 3	(8) epoxy, equipment
FM-18	Buried pipe couplings, valves, fittings, and flanged joints (where piping is plastic).	Removal of dirt, grease, oil	(201) rich portland cement mortar
FM-19	Buried pipe couplings, valves, and flanged joints (where piping is ductile or cast iron, not tape-coated), including factory-coated surfaces.	As specified by reference specification	(205) polyethylene encasement
FM-20	Buried pipe couplings, valves, and flanged joints (where piping is mortar-coated steel or reinforced concrete), including factory-coated surfaces.	Removal of dirt, grease, oil	(206) cement mortar coating

3.19 Coating System Schedule, Ferrous Metal - Galvanized: Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer.

Item	Surface Prep.	System No.
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP 1 (1) acrylic polymer
FMG-1	All exposed surfaces indoors and outdoors, except those included below.	Solvent cleaning SSPC SP 1 (4) epoxy/ polyurethane
FMG-2	Surfaces in chlorinator room, chlorine storage room.	Solvent cleaning SSPC SP 1 (100) amine cure epoxy
FMG-3	Buried small steel pipe.	Removal of dirt, grease, oil (200) PVC tape
FMG-4	Surfaces buried or submerged in water or wastewater, including all surfaces lower than two feet above high water level and all surfaces inside enclosed hydraulic structures and vents.	Solvent cleaning SSPC SP 1 followed by brush-off grade blast cleaning SSPC SP 7/NACE 4 (100) amine cure epoxy

3.20 COATING SYSTEM SCHEDULE, NON-FERROUS METAL, PLASTIC, FIBER GLASS

- A. Where isolated non-ferrous parts are associated with equipment or piping, the Contractor shall use the coating system for the adjacent connected surfaces. Do not coat handrails, gratings, frames or hatches. Only primers recommended by the coating manufacturer shall be used.

Item	Surface Prep.	System No.
NFS-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP 1 (1) acrylic polymer
NFS-1	All exposed surfaces, indoors and outdoors, except those included below.	Solvent cleaned SSPC SP 1 (4) epoxy/polyurethane
NFS-2	Chemical room.	Solvent cleaned SSPC SP 1 (100) amine cure epoxy
NFS-3	Aluminum surfaces in contact with concrete, or with any other metal except galvanized ferrous metal.	Solvent cleaned SSPC (208) aluminum metal isolation
NFS-4	Polyvinyl chloride plastic piping, indoors and outdoors, or in structures, not submerged.	Solvent cleaned SSPC (1) acrylic polymer
NFS-5	Fiber glass surfaces.	Per paragraph 3.10 (12) polyurethane, fiber glass
NFS-6	Buried non-ferrous metal pipe.	Removal of dirt, grease, oil (200) PVC tape

3.21 COATING SYSTEM SCHEDULE-CONCRETE

Item	Surface Prep.	System No.
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.10 (1) acrylic polymer
C-1	All surfaces indoors and outdoors, where indicated.	Per paragraph 3.10 (108) polyurethane, concrete
C-2	Surfaces submerged in water or wastewater, including (a) between 2-feet above high water elevation and 2-feet below low water elevation in an open structure and (b) all surfaces above 2-feet below low water elevation in an enclosed structure.	Per paragraph 3.10 (108) polyurethane, concrete
C-2	Surfaces submerged in water or wastewater, including (a) between 2-feet above high water elevation and 2-feet below low water elevation in an open structure and (b) all surfaces above 2-feet below low water elevation in an enclosed structure.	Per paragraph 3.10 (111) vinyl ester, concrete
C-3	Floor slab and walls, exposure to chemicals, where indicated.	Per paragraph 3.10 (109) epoxy, concrete
C-4	Walls, floors, exposure to chemical splash, washdown, where indicated	Per paragraph 3.10 (109) epoxy, concrete
C-5	Interior surfaces of sewer manholes, including sidewalls, bottom, and metal appurtenances, for manholes indicated.	Per paragraph 3.10 (111) vinyl ester, concrete
C-5	Interior surfaces of sewer manholes, including sidewalls, bottom, and metal appurtenances, for manholes indicated.	Per paragraph 3.10 (109) epoxy, concrete

3.22 COATING SYSTEM SCHEDULE-CONCRETE BLOCK MASONRY

	Item	Surface Prep.	System No.
CBM-1	All surfaces, indoors and outdoors, where indicated.	Per paragraph 3.10	(1) acrylic polymer
CBM-1	All surfaces, indoors and outdoors, where indicated.	Per paragraph 3.10	(108) polyurethane, concrete
CBM-2	Submerged in wastewater, including all vertical masonry surfaces above waterline where indicated.	Per paragraph 3.10	(108) polyurethane, concrete
CBM-3	Exterior surfaces, above grade, where indicated.	Per paragraph 3.11	(204) water-repellent

3.23 COATING SYSTEM SCHEDULE - MISCELLANEOUS SURFACES

	Item	Surface Prep.	System No.
MS-1	Wood, indoors and outdoors, and gypsum board indoors.	Per manufacturer's printed instructions	(1) acrylic polymer

END OF SECTION

**SECTION 23 05 00
GENERAL HVAC REQUIREMENTS**

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 work of this section.

Sections of other Divisions which relate to HVAC work apply to the work of this section. See various Sections on sitework, underfloor work, structural work, finish materials, etc.

Related Sections: Refer to Section 23 06 07 "Motors, Drives & Electrical Requirements" for basic electrical requirements for all HVAC equipment. Special and specific electrical requirements are specified within each respective equipment specification section.

Section 26 05 00 – "Electrical General Requirements" applies to the HVAC work.

- 1.2 SUMMARY:** This Section specifies the basic requirements for HVAC installations and includes requirements common to more than one of the Division 23 HVAC sections. It expands and supplements the requirements of Division 1 and the Mechanical Sections 21, 22 and 33.

This Division does not define, nor is it limited by, trade jurisdictions. All work described herein is a part of the General Contract and is required of the Contractor regardless.

- 1.3 DESCRIPTION OF PROJECT:** The HVAC work described in these Division 23 specifications is for The Lagoon Improvements project located in Mt Pleasant City, Utah. Design weather conditions are: 97°F db, 63°F wb and winter 0°F. Altitude readings, unless otherwise noted, are for an elevation of approximately 5,900 feet above sea level. Make adjustment to manufacturer's performance data as needed.

Work includes:

- A. HVAC systems for a new Screening Room and related facilities.

1.4 CODES AND PERMITS, AUTHORITIES HAVING JURISDICTION:

- A. Perform the HVAC work in strict accordance with the applicable provisions of the various codes. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications govern.
- B. Hold and save the Owner and Engineer free and harmless from liability of any nature or kind arising from Contractor failure to comply with codes and ordinances.
- C. Secure permits necessary for the prosecution of the work under this contract. Contractor to pay all fees.

D. Referenced Standards:

American Welding Society
International Mechanical Code/State Code
International Building Code/State Code
International Plumbing Code with amendments
International Fuel Gas Code 2006
SMACNA Duct Design Standards
Locally enforced NFPA Codes
 NFPA 90A related to general Heating and Ventilation
 NFPA 820 related to Ventilation of Water Treatment Plants
Local Fuel Utility Regulations
Local Power Utility Regulations
American Gas Association Standards
ASME Codes for Pressure Vessels and Piping
ANSI B31.1 Piping

- E. Review of work in progress will be made throughout the course of the work. Final review by the Engineer will not be made nor Certificate of Substantial Completion issued until certificates of acceptability from the Authorities having jurisdiction are delivered.

- 1.5 DEFINITION OF PLANS AND SPECIFICATIONS:** The HVAC drawings at reduced scale show the general arrangement of piping, ductwork, equipment, etc., and, after prior coordination, are to be followed as closely as the actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as part of the work insofar as these drawings furnish the Contractor with information relating to design and construction of the building. Structural, Architectural, Mechanical and Electrical drawings take precedence over HVAC drawings. Request clarification and participate in resolution in the event of conflict.

Because of the small scale of the HVAC drawings, it is neither possible nor intended to indicate all offsets, fittings and accessories which may be required. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such extensions, offsets, adaptations, fittings, valves and accessories to meet the conditions as may be required. Some small scale work is not shown such as control conduit and piping, incidental piping, and specialties. Only those who are experienced in this type of construction are invited to the work. Provide in complete detail as directed by note, specification, and common "good practice or standard."

Examine the actual construction site prior to bidding and obtain an understanding of the existing conditions under which the work will be performed. No allowances will be made for failure to make such examination.

During construction, set up the rough work, and verify the evolving dimensions governing the HVAC work at the building. Do not claim or expect extra compensation because of differences between actual dimensions and those indicated on the drawings. Examine adjoining work on which HVAC work is dependent for perfect efficiency, and report any work of other trades which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to unfavorable construction consequent conditions affecting the HVAC work.

1.6 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 3 through 44 for rough-in requirements.

1.7 HVAC INSTALLATIONS:

- A. Equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the installation of equipment.
- B. Coordinate HVAC equipment and materials installation with other building components.
- C. Verify all dimensions by field measurements.
- D. Arrange for chases, slots, and openings in other building components to allow for HVAC installations.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- F. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- G. Coordinate the cutting and patching of building components to accommodate installation of HVAC equipment and materials.
- H. Where mounting heights are not detailed or dimensioned, install HVAC services and overhead equipment to provide the maximum headroom possible.
- I. Install HVAC equipment to facilitate maintenance and repair or replacement of equipment

components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

- J. Coordinate the installation of HVAC materials and equipment above ceilings with suspension system, light fixtures, and other installations.
- K. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- L. Where HVAC work penetrates other trade work such as poured in place concrete, gypsum board or masonry walls, etc., penetration shall be neatly cut and sleeved, and the rough wall opening shall be filled and patched.

1.8 EQUIPMENT SUPPORTS AND FOUNDATIONS

- A. Equipment Supports: Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads as stated in the 2015 (or latest edition) International Building Code (IBC), Chapter 16 and ASCE 7-05. Submitted design calculations for equipment supports and anchorage shall bear the signature and seal of a Registered Professional Engineer licensed in the State of Utah, unless otherwise indicated. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, normal operation plus wind loadings, as well as the other load combinations stated the 2006 IBC.
 - 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.
- B. Wind Load: The wind load shall be calculated in accordance with ASCE 7-05, Chapter 6, using the following design parameters:
 - 1. Wind Speed: 90 mph
 - 2. Exposure: C
 - 3. Importance Factor: $I_w = 1.15$
- C. Seismic Loads: The seismic lateral and vertical forces shall be calculated in accordance with the ASCE 7-05, Chapters 11 and 13, using the appropriate design parameters for the respective site location. Provide values for the following categories as part of the Seismic Submittal.
 - 1. Site Class
 - 2. Seismic Design Category (SDC)

3. Seismic Importance Factor:
 4. Short Period Spectral Acceleration
 5. 1 Second Period Spectral Acceleration
- D. Hydrodynamic Forces: Hydrodynamic forces calculated in accordance with AWWA D100, API 650 or ACI 350.3-06 shall be based on the appropriate parameters for the respective site location. Provide values for the following categories as part of the Seismic Submittal.
1. Site Class
 2. Seismic Design Category (SDC)
 3. Seismic Importance Factor:
 4. Short Period Spectral Acceleration
 5. 1 Second Period Spectral Acceleration
- E. Anchors: Anchor bolts shall be in accordance with Section 05500 - Miscellaneous Metalwork, and shall be designed to resist the above loads. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all loads stated in the 2015 (or latest edition) IBC and ASCE 7-05, including lateral wind and lateral and vertical seismic loads. Reduction factors associated with edge distance embed length, and bolt spacing shall all be considered and based on the actual dimensions of the concrete that resists the anchorage forces. Anchor bolt details shall include required bolt diameter, embed, and edge distances. Further, the design of Anchors shall consider the ductility requirements stated in ASCE 7-05, Chapter 13, Section 13.4.2 and Chapter 15, Section 15.7.3. Anchor bolt calculations and details shall be submitted and shall bear the signature and seal of a Registered Professional Engineer licensed in the State of Utah.
- F. Equipment Foundations: Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 4-inch high concrete bases, unless otherwise indicated. Equipment foundations are indicated on Drawings. The CONTRACTOR, through the equipment manufacturer, shall verify the size and weight of equipment foundation to insure compatibility with equipment. The dimensions of all concrete bases shall be sufficient to provide the edge distances required by the anchor bolt calculations.

1.9 ACCESSIBILITY

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Extend all grease fittings to an accessible location.
- C. Establish required clearance to all installation features involving operation and maintenance. Respect manufacturer's recommendations for access and clearance.
- D. Access Doors - General: All items of HVAC equipment which may require maintenance, replacement or which control a system function shall be made readily accessible to personnel operating the building.
 - 1. Provide access doors in all ductwork or plenums as required to maintain filters, dampers, equipment, controls or other elements of the system. Doors shall be double wall, framed, hinged and provided with latches and shall conform to SMACNA standards, unless otherwise detailed or specified.

1.10 CHANGE ORDERS: See General Conditions.

1.11 ALTERNATIVE CONSTRUCTION/SUBSTITUTION: These documents outline a way in which the Owner may be delivered a functional and reliable facility. Drawings and specifications describe reasonable engineering practice for the Contractor to follow.

Coordination between trades may result in periodic needs to adjust the installation from that indicated, but in no case shall the intended function be compromised.

The Contractor may perceive some material or work methods which differ from those specified which could save time and effort without compromising quality. These may be presented to the Engineer with a breakdown of possible cost savings for review. Implement changes only with authorization.

Materials substitutions will generally be covered in a review process prior to bidding. After bidding, material or equipment substitutions shall be proposed only on the basis of definitive cost accounting and implemented only with authorization.

1.12 CUTTING AND PATCHING

- A. Lay out the project where new work is involved ahead of time, providing sleeves and block outs, and have work specifically formed, poured and framed to accommodate HVAC installations. Cut and patch only as needed. Repair wall or floor where cutting and patching is needed to match existing.
- B. Refer to Division 26 Section: ELECTRICAL GENERAL REQUIREMENTS for requirements for cutting and patching for electrical equipment, components, and materials.
- C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

- D. Arrange for repairs required to restore other and any work damaged as a result of HVAC installations.
- E. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of HVAC equipment and materials required to:
 - 1. Uncover Work to provide for installation of ill-timed Work;
 - 2. Remove and replace defective Work;
 - 3. Remove and replace Work not conforming to requirements of the Contract Documents;
 - 4. Remove samples of installed Work as specified for testing;
 - 5. Install equipment and materials in existing structures.
- G. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.
- H. Cut, remove and legally dispose of selected HVAC equipment, components, and materials as indicated, including, but not limited to removal of HVAC piping and other HVAC items made obsolete by the new Work.
- I. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- J. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1.13 SUBMITTALS: Submittal of shop drawings, product data, and samples will be accepted only from the Contractor to the Engineer. Submittal shall meet the requirements of section 01 30 00 – Submittals. Data submitted from subcontractors and material suppliers directly to the Engineer will not be processed. There is opportunity and allowance for discussion prior to submittal. Document each transmittal at each transfer level of the process, and sign and stamp the submittal indicating that it has been reviewed and is in compliance with the criteria of the project, any exceptions being clearly noted. Submittals are to include all supporting calculations for the equipment, supports and anchorage of the equipment.

- A. **SHOP DRAWINGS:** As soon as possible after the contract is awarded, submit to the Engineer, an electronic copy of the descriptive literature covering all equipment and materials to be used in the installation of HVAC systems for this project. Obtain written confirmation of acceptable review by the Owner's Representative before ordering, purchasing, acquiring or installing any such equipment or materials for the project.

Prepare the submittals in an orderly manner after the order of this specification, with identification tabs for each item or group of related items. Clearly indicate performance,

quality, utility requirements, dimensions of size, connection points and other information pertinent to effective review.

Equipment must fit into the available space with allowance for operation, maintenance, etc. The Contractor shall take full responsibility for space and utility requirements for equipment installed. Do not submit anything that will not fit or will not work.

Factory-wired equipment shall include shop drawings of all internal wiring to be furnished with unit.

Review by the Engineer will be for general conformance of the submitted equipment of the project specification; in no way does such approval relieve Contractor of his obligation to furnish equipment and materials that comply in detail to the specification, nor does it relieve the Contractor of his obligation to lay out ahead of time to determine actual field dimensions and conditions which may affect his work.

- B. Record Drawings: See Division 1. During the course of construction, maintain a set of drawings, specifications, change orders, shop drawings, addenda, etc., for reference and upon which all deviations from the original layout are recorded. Turn these marked up documents over to the Engineer within 90 days of system acceptance so that the original tracings can be revised. If the Contractor fails to mark up the prints, he shall reimburse the Engineer for the time required to do so.

1.14 OPERATION AND MAINTENANCE TRAINING

- A. Instruction of Owner's Personnel: At a time prior to Owner making use of a device or system, and in general after testing and balance work for a building or major system is complete, prepare, schedule and conduct a series of training sessions for Owner's operating and supervisory personnel. Instructions shall cover each device and system with emphasis on understanding of the purpose and function, the maintenance requirements and the proper adjustment and operating technique.
- B. Instruct building operating staff in operation and maintenance of HVAC systems utilizing Operation and Maintenance Manual when so doing.
- C. Contractor to video tape instruction sessions, and give video tape to owner.
- D. Minimum instruction periods shall be as follows:
 - 1. HVAC - 20 hours, or more as needed, allocated among the various buildings and systems.
 - 2. Temperature Control - 8 hours, or more. Programming help as needed. Coordinate with Divisions 26 and 40 for Instrumentation and HVAC control.
- E. Initial instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made. Schedule subsequent visits with the Building Operation Personnel throughout the first year.

F. Vendors for each piece of equipment, controls, etc., shall participate along with the Contractor(s).

1.15 GUARANTEE/WARRANTY: The following guarantee is a part of this specification and is binding on the part of the Contractor and his assigns:

"Contractor guarantees that this installation is in accordance with the terms of the Contract and is free from HVAC defects. He agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance. See also the General Conditions of these specifications. Failed equipment in the repair or replacement shall be guaranteed for one full year from the date of "Substantial Completion."

Compile and assemble the warranties required by Division 23 into a separated set of vinyl covered, insert sheets, tabulated and indexed for each reference, included in the O & M Manual.

Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

HVAC systems and equipment shall not be considered for substantial completion and initiation of warranty until they have performed in service continuously without malfunction for at least thirty (30) working days.

1.16 TESTS AND CERTIFICATIONS: Make all tests required by code or specification in the presence of a representative of the Owner, with tests recorded and certified by the Contractor and Representative. Involve local authorities where required.

1.17 PERMITS, FEES, LICENSES: Refer to General Conditions.

1.18 CEILING SPACE AND OPEN SPACE COORDINATION: Carefully coordinate ceiling cavity and open space with all trades; however, installation of HVAC equipment within the ceiling cavity space allocation, in the event of conflict, shall be in the following order: process piping, cable tray plumbing waste lines; supply, return and exhaust ductwork; domestic hot and cold water; fire protection; control conduit. Respect clearances required for lights, electrical conduits, protected structure, etc. All spaces above any and all ceilings shall be defined and considered as return air plenum space.

1.19 HVAC RELATED CONTROLS AND INSTRUMENTATION

A. The Instrumentation and Controls for HVAC systems installed by this project are to be provided under Divisions 26 - Electrical and Division 40 – Process Interconnections but to be fully supported and complemented in a conventional

way by providers of Sections 23 work. Extent of control systems work required by this section is indicated on drawings and schedules, and by requirements of this section.

1. See following sections for Control Systems and instrumentation requirements:
 - a. Section 26 05 00 – Electrical General Requirements
 - b. Section 40 10 00 – Process Control and Instrumentation System – General
 - c. Section 23 09 00 – HVAC Control Systems
 2. Control sequences will be provided for Owner's programming. See Division 40.
- B. Provide for installation of instrument wells, valve bodies, and dampers in mechanical HVAC systems.
- C. Include Divisions 26 – Electrical and 40 – Instrumentation sections in the following work.
1. Power supply wiring from power source to power connection on controls and/or unit control panels. Includes starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
 2. Interlock wiring between electrically operated equipment units; and between equipment and field installed control devices. Interlock wiring specified as factory installed is work of this section.
 3. Control wiring between field installed equipment, controls, indicating devices, and unit control panels.
 4. 24 volt and 120 volt service work required by instrumentation/control systems.
- D. Participate in "System Commissioning, Testing and Balancing".

PART 2 – PRODUCTS

2.1 QUALITY AND CHARACTER OF MATERIALS AND EQUIPMENT:

- A. New and conventional: All equipment and materials shall be new, and shall be the standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment, and shall be the manufacturer's latest design. Specific equipment shown in schedules on drawings and specified herein is to be the basis for the Contractor's bid. Provisions for substitute equipment are outlined in the General Conditions.
- B. Complete: Furnish and install all major items of equipment herein specified and/or called out in the equipment schedules on the drawings complete with all accessories normally supplied with catalog items listed, and with all other accessories necessary for a complete and satisfactory installation.
- C. Code Compliant: There are certain Code defined hazards associated with the Waste Water Treatment Plant environment, generally outlined in NFPA Standard 820. The Contractor in all if its entities should be familiar with the standard and provide installations which will be compliant in all regards. Of particular interest are the requirements where vagrant flammable process gases such as methane and hydrogen sulfide may develop. Such areas include the Wet Wells, Grinder Rooms and other similarly classified spaces where exhaust fans are involved to dilute the concentration of gases. All HVAC equipment involved in these areas must have an "explosion-proof" characteristic. Impose this requirement on all materials, motors, etc. provided by these Division 23 specifications.

2.2 PROTECTION OF MATERIALS AND EQUIPMENT:

- A. Close pipe and duct openings with caps or plugs to prevent lodgement of dirt or trash during the course of installation. Cover equipment tightly and protect against dirt, water and chemical or HVAC injury. Plumbing fixtures intended for the final installation shall not be used by the construction forces. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly and deliver in a factory dock condition for the Owner's acceptance. Make damage and defects developing before acceptance of the work good at Contractor's expense.
- B. Do not make temporary use of project equipment, during construction. **DO NOT USE PERMANENT HVAC SYSTEMS FOR TEMPORARY HEAT!!**

2.3 QUALIFICATIONS OF WORKMEN:

- A. All mechanics shall be capable journeymen, skilled in the work assigned to them. Apprentices may be used with appropriate direction.
- B. Do not employ unskilled persons in the work; execute all work in a skillful and workmanlike

manner. All persons employed shall be competent, faithful, orderly and satisfactory to the Owner. Should the Owner's Representative deem anyone employed on the work incompetent or unfit for his duties, and so certify, Contractor shall remove that employee from this project and he shall not be again employed upon the project without permission of the Owner's Representative.

- C. All welders involved in welding of pressure piping systems shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Written verification of successful test completion shall be submitted to Architect prior to initiating work.

2.4 FOREMAN: Designate an experienced and qualified general HVAC foreman for the project work to be consistently available on site during the life of the project for consultation. Do not replace this individual without prior approval from the Owner's Representative.

2.5 USE OF COMMON VENDORS: Regardless of subcontract delegations, coordinate purchasing between trades so that equipment and materials of similar nature come from a single vendor, i.e., all package HVAC units shall be common source. Valves, variable volume boxes, etc., the same. Do not burden the Owner with multiple brands of similar equipment unless so directed.

2.6 ROOF/WALL/FLOOR PENETRATIONS - FLASHINGS:

- A. Install sleeves through the floor into dry rooms flush with the floor, caulked and sealed. Into wet rooms, extend piping above floor level to create 1" dam. Use Schedule 40 galvanized steel pipe for all pipe sleeves.
- B. Let pipe sleeves allow for movement of the pipe due to expansion and contraction, yet to include seismic restraint.
- C. Fire stopping: Provide fire stopping for all Division 23 penetrations of rated walls, floors, structure, etc. in conformance with ASTM E814 and with UL 1479.
- D. Flashings:
 - 1. Flash all equipment supports, pipes and conduit penetrating the roof. Provide required flashing components. See drawings or Architect/Engineer for additional detail.
 - 2. Clamp roof drains to roof membrane, follow manufacturer's directions.
 - 3. Make all ductwork penetrating a roof watertight with flashings, counter flashing and sealant. Provide curbs for any and all such openings.

2.7 EXCAVATING AND BACKFILLING (GENERAL): Reference, if required.

- A. Provide all excavation, trenching and backfilling for HVAC underground duct and piping work. Excavation and backfilling shall comply with applicable paragraphs of Division 31. Tamp bottoms of trenches hard and, for soil and waste piping, grade to secure uniform fall of 1/4" per foot, or as noted. Excavate bell holes for hub and spigot pipes so that pipe rests on solid ground for its entire length. Lay sewer and water pipe in separate trenches, except where otherwise noted, as detailed.
- B. After work has been tested, inspected and approved by the Owner's Representative and/or State/Local Inspector, and prior to backfilling, clean the excavation of all rubbish, and clean backfill materials free of trash. Place backfill in horizontal layers not exceeding 12" in thickness, properly moistened. Compact each layer with suitable equipment to a dry density of not less than 95 percent as determined by the Modified AASHO Test T-180. See Division 31 for additional requirements.
 - 1. Provide adequate shoring to safeguard workers from cave-ins for all excavations.
 - 2. In areas where General Contractor has finish grade work to do, HVAC Contractor shall backfill and compact to 8" below finish grade. Where no finish surface work is to be done, HVAC Contractor shall backfill and compact to and match adjacent undisturbed surface with allowance for settling, etc.
 - 3. Protect from damage all existing underground utilities or utility tunnels indicated on the contract drawings (or field located for the Contractor by the Owner prior to excavation operations). Any damage to identified existing utilities or utility tunnels shall be repaired by the Contractor at no cost to the Owner.

2.8 HANGERS AND SUPPORTS (GENERAL):

- A. Provide mountings, hangers and/or supports for all HVAC equipment, piping and ductwork. Primary information is contained in these specifications as noted in, but not limited to, paragraph 1.8 above and on the drawings. Correlate HVAC work with the work of other trades to obtain a consistent manner of installation.
- B. Provide hangers and supports to correlate with seismic restraint, expansion/contraction, and vibration isolation.

2.9 MANUFACTURER'S DIRECTIONS: Install all equipment in strict accordance with directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, report such conflicts to the Engineer.

2.10 LUBRICATION: Lubricate equipment at startup. Then, provide all lubricants for the operation of all equipment until acceptance by the Owner. The Contractor is held responsible for all damage to equipment consequent to pre-acceptance operation.

2.11 ELECTRICAL WIRING AND CONTROL:

- A. In general, primary motor starters, related motor starter equipment and power wiring

indicated on the electrical drawings and control diagrams are to be furnished and installed under the Division 26 Specification. Items of electrical control equipment specifically mentioned to be furnished by the HVAC/Instrumentation (Controls) Contractor either in these specifications or on the related drawings, shall be obtained and mounted by this Contractor and shall be connected under and as required by specifications, all in compliance with the National Electric Code, and Divisions 26 and 40. Many control devices and fan motors are to be furnished and terminal block wired to a unit mounted power or control panel. The project requires this single location of connection for fan and pump motors, damper actuators, valve actuators, sensors smoke detectors and the like.

- B. Refer to the control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the contractor.
- C. HVAC electrical work must be fully coordinated with Division 26 to insure that all required components of the work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of coordination.
- D. Where the detailed electrical work is not shown on the electrical drawings, the HVAC Contractor shall furnish, install and wire or have prewired all specified and necessary controls for package air equipment specified for this project. The objective of this paragraph is to make sure a complete operating system is obtained at no additional cost to the Owner for field wiring required related to the equipment.

2.12 FLUSHING AND DRAINING OF SYSTEMS/CLEANING OF PIPING AND DUCTS: Blow out all refrigerant piping systems with compressed air or nitrogen to remove foreign materials that may have been left or deposited in the piping system during its erection. Duct systems shall have all debris removed and fans shall be run to blow out all dust and foreign matter before outlets are installed and connected.

Damp wipe all ductwork on installation, cap open ducts, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

2.13 JOBSITE CLEANUP:

- A. Keep site clean during progress of work.
- B. At the conclusion of work, clean all installation thoroughly.

Leave equipment in a factory dock condition. Correct any damage and touch up or repaint if necessary.

Remove all debris from site.

END OF SECTION

**SECTION 23 05 20
HVAC IDENTIFICATION**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23 Basic HVAC Materials and Methods section apply to work of this section.

1.2 SUMMARY:

- A. Label all heating, air conditioning, automatic temperature control equipment (excluding thermostats), and distribution systems. Also label all electrical switches and starters for all HVAC equipment.

PART 2 – GENERAL MECHANICAL MATERIAL AND METHODS

2.1 EQUIPMENT, PIPE AND DUCT IDENTIFICATION:

- A. Equipment Identification:
 - 1. Identify all equipment including, but not limited to, all mechanical equipment, ATC panels, controller, etc., and all other devices with signs made of laminated plastic with 1/8" or larger engraved letters.
 - 2. Give each piece of equipment its own unique equipment number or symbol.
 - 3. Information on sign shall include name of equipment, identification on plans and schedules, rating, maintenance instructions, and any other important data not included on factory attached name plate.
 - 4. Signs shall be attached to equipment so they can be easily read. Attachment shall be by rust proof screws or rivets. Do not use adhesive.
 - 5. Identification signs for equipment shall be similar to the following:
 - a. Supply Fan (F-2)
 - Rating: 49,850 cfm @ 3.5" s.p. (At 1600 ft. elevation)
 - Maintenance: Check bearings for lubrication every 30 days and lubricate as required with S.A.E. 30 oil.
 - b. "ATC Panel A"

B. Duct Identification:

1. Ductwork shall be identified at or near the fan, with stenciled signs or by engraved laminated plastic signs secured with rust proof screws. Sign shall indicate area served.
2. Identify all ducts exposed in mechanical equipment room. A sample duct identification shall be as follows: "Supply Hot Duct-Heating Administration."
3. Identify all fire and fire/smoke dampers, stencil designation on damper access doors.

2.2 PANEL IDENTIFICATION:

- A. Provide all panel devices on panel faces with engraved black face Formica with white engraved lettering labels.
- B. Provide all internal panel components with engraved black face Formica labels with white engraved lettering. Fasten label beneath each device.
- C. Numerically or alphabetically code all panel wiring and tubing.

END OF SECTION

**SECTION 23 05 30
HVAC OPERATION & MAINTENANCE MANUALS**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. Division-23, Section 23 05 00 General HVAC Requirements sections apply to work of this section.

1.2 SUMMARY:

- A. Furnish four sets of bound operation and maintenance (O&M) manuals within 90 days of system acceptance. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to operate, maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

1.3 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL HVAC SYSTEMS:

- A. General:
 - 1. The "Operating and Maintenance Manual" is a bound compilation of drawings and data that the owner requires for each building or project. Furnish these manuals, complete with drawings and data, to the Owner through the Engineer.
 - 2. The mechanical contractor has overall responsibility to obtain the necessary data from and compile the data as set forth in this specification.
 - 3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.2A.
 - 4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART 2 – MATERIALS AND METHODS

- 2.1 PAGE SIZE:** All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 17 x 11 inches) folded to 8-1/2 x 11 inch.

2.2 DRAWINGS: All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.3 BINDERS: Binders shall be piano hinge, bar-lock type, Buckram (stiffened fabric cover) binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, on not filling them beyond 4".

A. Place the following information on the front cover and backbone:

1. "Operation and Maintenance Manual".
2. Project Name (and volume number if more than one volume).
Project Number (Per owner's project number).
3. Building name and number.
4. Owner's name.
5. (Architect's name.)
6. Engineer's name.
7. General Contractor's name.
8. HVAC Contractor's name.

Items 5 through 7 need not be printed on the backbone.

2.4 CONTENTS AND INDEXING:

- A. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
- B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.
- C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:
 1. 11 x 17 size project drawings in "As-built" condition.
 2. Outline drawings, special construction details, "As built" electrical wiring and control diagrams for all major and supplementary systems.
 3. Manufacturer's test or calculated performance data and certified test curves.

4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
5. Manufacturer's brochures marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included. Include performance data similar if not equivalent to the shop drawing submittal.
6. List the serial numbers of each item of equipment installed with the model numbers and plan symbols.
7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

Part I	Building and System Descriptions
Part II	Purchased Equipment Data
Part III	Test Reports and Valve Charts
Part IV	Start-Up and Operation
Part V	Preventative Maintenance Recommendations
8. A copy of the approved submittals for each piece of equipment.
9. A copy of all testing, adjusting and balancing reports.
10. Wiring diagrams, marked with model and size and plan symbol.
11. Operating and Maintenance Manuals data for Part I shall be obtained directly from the mechanical and electrical consultants. (Allow consultant preparation cost.)
12. The index for each section shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

PART 3 – EXECUTION

(Not Used)

END OF SECTION

**SECTION 23 05 93
TESTING, ADJUSTING & BALANCING**

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

- A. Work of this section shall be subject to the requirements of the General Conditions of this contract, the Mechanical - General Requirements, HVAC General Requirements, General Electrical Requirements and other sections where this work shares a responsibility.
- B. System commissioning and startup of the HVAC systems shall be the responsibility of the HVAC Division 23 Contractor and his subcontractors with the participation of the Divisions 26/40 Electrical and Instrumentation Contractor(s) related to electrical and instrumentation work and the General Contractor related to general construction items.
- C. Testing and balancing shall be under the direction of the General Contractor with the full participation of all of the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance subcontractor to coordinate all elements of the work and to perform special technical services outlined herein.

1.2 SYSTEM COMMISSIONING - SCOPE OF WORK:

- A. The work required under this section shall include but not necessarily be limited to the following:
 - 1. The pre-startup inspection of all HVAC systems and subsequent correction of any incorrect items.
 - 2. The initial first run inspections.
 - 3. System operations inspection.
- B. The intent of this section is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balancing. See section for balancing of air system. After completion of the balancing, the mechanical system shall be ready for owner occupancy, with all systems operating as intended.
- C. Repair, replacement or adjustment of each item shall be performed by the respective installing subcontractor.

1.3 TESTING AND BALANCING - SCOPE OF WORK:

- A. This work incorporates a checkout of construction work, individual component activation and overall system activation into one work program which shall serve as the transition period from the Contractor's job to Owner's facility.
- B. The Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.

- C. The Contractor shall participate in the startup and shakedown of all mechanical systems installed and modified in this contract; test adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit a complete report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.

1.4 QUALIFICATIONS OF SYSTEM COMMISSIONING AND TAB TEAM:

- A. Representatives of Contractor shall be available on a daily basis through the commissioning and adjustment period. These men shall be experienced journeymen with prior experience in system operation and with specific experience on the construction of this project. Section 23 09 00 – HVAC Control Systems is a particular participant in the work.
- B. Balancing shall be done at the Contractor's expense by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with any engineering, contracting, or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. Approved firms to do this work include:

Bob's Test and Balance – Salt Lake City, UT
Certified Test and Balance – Salt Lake City, UT
Barnett, Inc. (Payson Sheet Metal) – Payson, UT

- C. The balancing work shall be performed by the same firm having total professional responsibility for the final testing, adjusting and balancing of the entire system. A principal of the firm shall be directly involved in the project.
- D. The testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.
- E. After all adjustments are made a detailed written report shall be prepared and submitted for approval, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a satisfactory report is received. Furnish an electronic copy of the report for Engineer Review.
- F. Treat each individual system as separate elements for reporting purposes.

PART 2 – EXECUTION, SYSTEM COMMISSIONING

2.1 PRE-STARTUP INSPECTION:

- A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.

- B. All pertinent items shall be checked, including but not necessarily limited to the following:
1. Removal of shipping stops.
 2. Vibration isolators properly aligned and adjusted.
 3. Flexible connections properly aligned.
 4. Belts properly adjusted.
 5. Belt guards and safety shields in place.
 6. Safety controls, safety valves and high or low limits in operation.
 7. Filters in place and seal provided around edges.
 8. All test stations and measuring devices installed.
 9. Initial lubrication of equipment is complete.
 10. Filters are clean.
 11. Motor rotations are correct.
 12. Voltages match nameplate.
 13. Control system is in operation.
 14. All interlocks are wired and verified.
 15. All controls have been connected and verified.
 16. All dampers and operators are properly installed and operating.
 17. All ductwork is installed and connected.
 18. All other items necessary to provide for proper startup.
- C. Correct all incomplete or defective items.

2.2 FIRST RUN INSPECTION:

- A. Recheck all items outlined in pre-startup inspection to insure proper operation.
- B. Check the following items:
1. Excessive vibration or noise.
 2. Loose components.
 3. Initial control settings.
 4. Motor amperages.
 5. Heat buildup in motors, bearings, etc.
 6. Control system is properly calibrated and functioning as required.
- C. Correct all items which are not operating properly.

2.3 SYSTEM OPERATION INSPECTION:

- A. Observe the mechanical systems under operating conditions for sufficient time to verify proper operation under varying conditions, such as day-night and heating-cooling.
- B. Periodically check the following items:
1. Filters.
 2. Visual checks of air flow for "best guess" settings for preparation for system air balancing under section applying.

3. Control operation, on-off sequences, system cycling, etc.
4. Visual checks of seals, packings, operation pressures.
5. Cleaning of excessive oil or grease.
6. Dampers close tightly.
7. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

PART 3 – EXECUTION – TESTING AND BALANCING

3.1 TOTAL MECHANICAL SYSTEM BALANCE:

- A. The mechanical systems consist of many elements. Total system balance requires that all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties is required in the test and balance procedure.
- B. Prior to beginning work, submit a written description of the anticipated sequence of action to the Engineer for review and comment.
- C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Engineer of any modifications to the layout which he might suggest to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.
- D. The test and balance specialist shall visit the project from time to time during the rough installation making a thorough inspection of those items which will affect his subsequent work. He shall advise the Contractor in writing with a copy to the Engineer of any work required by the contract which is not being performed adequately. This is in addition to the regular review efforts of the Engineer.

3.2 AIR SYSTEMS BALANCE:

- A. Before any adjustments are made, the systems shall be checked for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. All fan systems are to be adjusted to deliver design air quantities within +5%. Design static pressure is based on filters approximately 50% loaded with dirt. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed, check motor amperage with the filters clean.
- B. Adjust exhaust air systems for air quantities shown on drawings and the proper relationship between supply and exhaust established.
- C. Exchange sheaves and/or belts as needed to adjust the RPM of all fans so they handle specified air quantity.
 1. Determine the sheave on supply fans so that the VFD driven fan will deliver not less than 100% cfm with fully loaded filters.

2. Determine the sheave on the exhaust fans so that the VFD driven fan will fully load the motor at design cfm and 100% speed.
- D. Verify the proper operation of all air side related control functions.

3.3 MAJOR EQUIPMENT:

- A. The Testing and Balancing subcontractor shall work with the Instrumentation/Controls Contractor, Owners technical staff, and Electrician in placing new fans, and other major equipment in operation. The factory representative of the equipment manufacturer shall also participate in a team effort to place this system(s) in all anticipated operating modes and make adjustments as required to obtain correct operation. The Project Engineer shall witness the final operating sequence.

3.4 INSTRUMENTATION/CONTROL SYSTEMS:

- A. The Testing and Balancing Contractor shall go through the entire HVAC portion of the PLC based instrumentation and control system with the Instrumentation Contractor and Owner's technical staff, verifying proper operation of each and every device and the proper function of each system. The report shall indicate and certify such effort.

3.5 MISCELLANEOUS:

- A. Observe all furnished thermal overload protection and note such in the data sheets. If thermal overload protection is incorrect, it shall be the responsibility of the trade or vendor which furnished the overload devices to furnish and install the correct size overload protection devices, and it is the responsibility of the balancing firm to verify that proper overload protection has been installed at the completion of the job.
- B. The adjusting crew shall measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.
- C. When deemed necessary, take 24-hour space temperature recording and any required partial rebalance of the system shall be performed without additional cost. Successful function supercedes nominal settings in order of importance.

3.6 REPORT:

- A. Provide a bound report in four copies which shall contain a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.

- B. Provide equipment data sheets listing make, size, serial number, rating, etc., of all mechanical equipment including fans, motors, starters and drives. Operating data shall include rotational speed, pressure drop across filters, coils, and other

system components and measured motor current and voltage.

- C. Reports shall contain a reduced set of contract drawings with outlets marked thereon for easy identification of the nomenclature used in the data sheets.
- D. The report shall contain any abnormal or notable conditions not covered in the above.
- E. Keep and submit a copy of a daily log of all work performed with a list of work scheduled for the day and the workers on the job.

END OF SECTION

**SECTION 23 06 03
SUPPORTING DEVICES FOR HVAC**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. This section is a Division-23 Basic HVAC Materials and Methods section, and is part of each Division-23 HVAC section making reference to supports and anchors specified herein.
- C. This section heavily references Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) manuals of standard practices.

1.2 SUMMARY:

- A. Extent of supports and anchors described by this section is generally indicated on drawings and/or specified in other Division-23 HVAC sections. Much support and anchorage is implied in that all HVAC installation, piping, ductwork, equipment and specialties require support and restraint. Correlate this section with Section 23 06 05 related to sound, vibration and seismic restraint.
- B. Types of supports and anchors specified in this section include the following:
 - 1. Horizontal-Piping Hangers and Supports.
 - 2. Vertical-Piping Clamps.
 - 3. Hanger-Rod Attachments.
 - 4. Building Attachments.
 - 5. Saddles and Shields.
 - 6. Miscellaneous Materials.
 - 7. Anchors.
 - 8. Equipment Supports.
- C. Supports and anchors furnished as part of factory-fabricated equipment are specified or presumed as part of equipment assembly.
- D. Relate this section to Section 23 06 05 regarding seismic and vibration control.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. Typical vendors of support systems include Grinnell.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

B. Shop Drawings:

1. Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division-1.

1.5 REFERENCES:

A. Codes and Standards:

1. Code Compliance: Comply with applicable building, mechanical and plumbing codes pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
3. MSS Standard Compliance:

Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

Select and apply pipe hangers and supports, complying with MSS SP-69.

Fabricate and install pipe hangers and supports, complying with MSS SP-89.

Terminology used in this section is defined in MSS SP-90.

PART 2 – PRODUCTS

2.1 HORIZONTAL-PIPING HANGERS AND SUPPORTS:

- A. General: Except as otherwise indicated, provide factory- fabricated horizontal piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
- B. Adjustable Steel Clevises Hangers: MSS Type 1. (For suspension of non-insulated or insulated stationary pipe lines; 1/2" to 30".)
- C. Steel Double Bolt Pipe Clamps: MSS Type 3. (For suspension of pipe requiring up to 4" of insulation and where flexibility of clamp is desirable; 3/4" to 24".)
- D. Steel Pipe Clamps: MSS Type 4. (For suspension of cold pipe lines or hot lines where little or no insulation is required; 1/2" to 24".)

- E. Pipe Hangers: MSS Type 5. (For suspension of piping when off-center closure allowing installation of hanger before erection of piping is desired; 1/2" to 4".)
- F. Adjustable Swivel Pipe Rings: MSS Type 6. (For suspension of non-insulated stationary pipe lines; 3/4" to 8".)
- G. Adjustable Steel Band Hangers: MSS Type 7. (For suspension of non-insulated stationary pipe lines; 3/4" to 8".)
- H. Adjustable Band Hangers: MSS Type 9. (For suspension of non-insulated stationary pipe lines; 1/2" to 8".)
- I. Adjustable Swivel Rings, Band Type: MSS Type 10. (For suspension of non-insulated stationary pipe lines; 3/8" to 8".)
- J. Split Pipe Rings: MSS Type 11. (For suspension of non-insulated stationary pipe lines; 3/8" to 3".)
- K. Extension Split Pipe Clamps: MSS Type 12. (For suspension of non-insulated stationary pipe lines; 3/8" to 3".)
- L. U-Bolts: MSS Type 24. (For support of heavy loads; 1/2" to 30".)
- M. Clips: MSS Type 26. (For support of uninsulated piping not subject to expansion or contraction.)
- N. Pipe Saddle Supports: MSS Type 36, including steel pipe base- support and cast-iron floor flange. (To support pipe from floor stanchion, using floor flange to secure stanchion to floor 4" to 36".)
- O. Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange. (To Type 36 except U-bolt provided for retaining pipe.)

2.2 VERTICAL-PIPING CLAMPS:

- A. General: Except as otherwise indicated, provide factory- fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
- B. Two-Bolt Riser Clamps: MSS Type 8. (For support and steadying of pipe risers; 3/4" to 20". Also supports pipe covering or insulation.)
- C. Four-Bolt Riser Clamps: MSS Type 42. (When longer ends are required for riser clamps.)

2.3 HANGER-ROD ATTACHMENTS:

- A. General: Except as otherwise indicated, provide factory- fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
- B. Steel Turnbuckles: MSS Type 13. (For adjustment up to 6" for heavy loads.)
- C. Steel Clevises: MSS Type 14. (For use on high temperature piping installations.)
- D. Swivel Turnbuckles: MSS Type 15. (For use with split pipe rings, MSS type 11.)
- E. Malleable Iron Sockets: MSS Type 16. (For attaching hanger rod to various types of building attachments.)

2.4 BUILDING ATTACHMENTS:

- A. General: Except as otherwise indicated, provide factory- fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
- B. Concrete Inserts: MSS Type 18. (For upper attachment for suspending pipe hangers from concrete ceiling.)
- C. Top Beam C-Clamp: MSS Type 19. (Use under roof installations with bar joist construction, for attachment to top flange of structural shape.)
- D. Side Beam or Channel Clamps: MSS Type 20. (For attachment to bottom flange of beams, channels, or angles.)
- E. Center Beam Clamps: MSS Type 21. (For attachment to center of bottom flange of beams.)
- F. Welded Beam Attachments: MSS Type 22. (For attachment to bottom of beams where loads are considerable and rod sizes are large.)
- G. C-Clamps: MS Type 23. (For attachment to structural shapes.)
- H. Top Beam Clamps: MSS Type 25. (For attachment to top of beams when hanger rod is required tangent to edge of flange.)
- I. Side Beam Clamps: MSS Type 27. (For attachment to bottom of steel I-beams.)
- J. Steel Beam Clamps with Eye Nut: MSS Type 28. (Same as Type 28 with link extensions.)
- K. Linked Steel Clamps with Eye Nut: MSS Type 29. (Same as Type 28 with link extensions.)
- L. Malleable Beam Clamps: MSS Type 30. (For attachment to structural steel.)

- M. Steel Brackets: One of the following for indicated loading:
 - 1. Light Duty: MSS Type 31, to 570 pounds.
 - 2. Medium Duty: MSS Type 32, to 1,500 pounds.
 - 3. Heavy Duty: MSS Type 33, to 3,000 pounds.
- N. Side Beam Brackets: MSS Type 34. (For use on sides of steel or wooden beams.)
- O. Plate Lugs: MSS Type 57. (For attachment to steel beams where flexibility at the beam is desired.)
- P. Horizontal Travelers: MSS Type 58. (For supporting piping systems subject to linear horizontal movements where head room is limited.)

2.5 SADDLES AND SHIELDS:

- A. General: Except as otherwise indicated, provide protection saddles or thermal hanger shields with protection shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
- B. Protection Saddles: MSS Type 39; see section Mechanical Insulation for void fill requirements. Use for roller supports and on all pipes 10" and larger.
- C. Protection Shields: See section Mechanical Insulation.
- D. Thermal Hanger Shields: See section Mechanical Insulation.

2.6 MANUFACTURERS OF HANGERS AND SUPPORTS:

- A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
 - 1. Kin-Line, Inc.
 - 2. Fee & Mason Mfg. Co.; Div. Figgie International
 - 3. ITT Grinnel Corp.

- 2.7 **OUTSIDE AREAS:** Use galvanized hangers, attachments, rods, nuts, bolts and other accessories for all outside areas.

2.8 MISCELLANEOUS MATERIALS:

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration. Use Embecco or Engineer approved equal grout for non-shrink applications.

- D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi- steel or heavy fabricated steel, consisting of bolted two- section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 – EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION:

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS:

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through the openings at the tops of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS:

- A. General: Install hangers, supports, clamps and attachments to rigidly support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Prevent electrolysis in support of copper tubing by the use of hangers and supports which are copper plated, or by isolating with foam rubber covering or 30 mil insulating tape.
- D. Provisions for Movement:

Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

Install supports within 2 feet of non-vertical flex connectors

- E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
- G. Insulated Piping: Do not allow hangers to come in contact with pipe where pipe is specified to be insulated.
- H. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
- I. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized steel protective shields. Install calcium silicate blocks (12" long minimum) at support points.
- J. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.5 INSTALLATION OF ANCHORS:

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer for loading and stresses to connected equipment.
- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 EQUIPMENT SUPPORTS:

- A. Concrete curbs for exterior mounted HVAC equipment shall be provided by the General Contractor. Anchor to curbs provided. Provide weather tight seal.
- B. Provide structural steel supports for equipment not floor or wall mounted. Construct of structural steel members or steel pipe and fittings.

3.6 ADJUSTING AND CLEANING:

- A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
- B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
- C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 06 05
MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS:** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

This section is a Division-23 Basic HVAC Materials and Methods section, and is part of each Division-23 HVAC section making reference to pipes and pipe fittings specified herein.

- 1.2 SUMMARY:** Furnish and install complete support, restraint and vibration control systems for all work installed under Division 23 HVAC sections. Work to be responsive to the intent of the International Building Code, latest adopted edition, for the respective seismic zone. Correlate this work with 23 06 03 related to general supports of Mechanical / HVAC systems and equipment.

1.3 QUALITY ASSURANCE:

- A. **Manufacturer's Qualifications:** Engage the services of an independent support, restraint and vibration control subcontractor who has the technology, the experience, computer capabilities and manufactured products to prepare the required computations, shop drawings and special devices to meet the minimum requirements described herein.

The support, restraint and vibration control subcontractor shall visit the site during construction at a minimum of two specific periods.

1. When equipment is set in place, prior to placement of seismic restraint devices for the purposes of directing the contractor in properly locating and installing the approved devices.
2. At the completion of the project, prior to final mechanical inspection, for the purpose of verifying the correctness of the support, restraint and vibration isolation device installation and preparing certification of the vibration-isolation work.

The support, restraint, vibration control subcontractor shall exercise the quality control for this work and shall include, but not be limited to instructions direct to the Mechanical (Division-23 and Division-33) Contractor concerning:

Anchoring of all mechanical equipment.

Vibration mounting of equipment.

Equipment base coordination with restraint requirements.

Snubbing of equipment.

Bracing and anchoring of ductwork, piping and conduit.

Provision for vibration of piping.

Concrete and/or steel pads or bases to assure proper mounting of restraints and isolators.

Vibration isolation of exhaust fans, ventilation fans, other rotating equipment.

The subcontractor shall be responsible for identifying the need for the size and location of steel sole plates and their attachment to structural steel or concrete.

The subcontractor shall certify in writing that he has inspected the installation and that all isolation, anchors and seismic restraint materials are installed correctly and functioning properly. Certification shall be provided after all corrective work has been completed.

1.4 SUBMITTALS: Submittal data is required and shall consist of computations, vibration isolation selection, equipment anchors, anchor bolt sizes, supports, seismic restraints, sole plate data, restraint locations and type of restraints.

Submittal data shall identify dimensions, load deflection data, center of gravity, standard connections, manufacturer's recommendations, behavior problems including vibrations, thermal expansion, building expansion joints, etc., associated with equipment, ductwork, piping and conduit.

Calculations need not be submitted when restraint devices for piping, conduit and ductwork are proposed in accordance with the SMACNA Guidelines for Seismic Restraints.

Selection of isolator anchors and restraints shall be clearly made known along with the basis for selection so that proposed systems can be reviewed.

Calculations furnished for anchors, anchor bolts, sole plates and other support steel for restraining devices shall be signed and stamped by an engineer licensed in the State of Utah.

1.5 REFERENCES:

A. Codes and Standards:

International Building Codes	Latest Adopted Edition
NFPA bulletin 90A,	Latest Adopted Edition
UL Standard 181	Latest Adopted Edition
National Electric Code	Latest Adopted Edition

Guidelines for seismic restraint of Mechanical Systems and Plumbing Piping Systems. Published by the Sheet Metal Industry Fund of Los Angeles, California, and the Plumbing and Piping Industry Council, Inc., Los Angeles, California.

PART 2 - PRODUCTS

2.1 MATERIALS - PRODUCTS: Restraint devices shall be especially designed to resist system induced forces in all directions.

A. Snubbers: Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer neoprene (bridge bearing neoprene) to protect equipment. Restraints shall allow a maximum of 1/4" before engaging and shall not interfere in normal starting or stopping operation. Housing shall allow for visual inspection to determine clearances during system

operation. Restraints shall be field adjustable and be positioned for up to 1/4" clearance both horizontally and vertically. Mountings and snubbers are to be manufactured under a Quality Assurance (QA) Program.

- B. Snubbers and Isolator Combination Devices: Combination unitized devices may be used where equipment isolation is required. They shall include the requirements listed for snubbers. Isolation portion shall be stable spring type with combination leveling bolt and equipment fastening device. Base plate shall have adequate means for bolting to structure. The spring assembly shall be removable and shall fit within a welded steel enclosure.
- C. Piping, Conduit and Duct Restraints: Restraint materials for exposed installation shall be standard fabricated flat steel, angle rod and channel members. Restraint members shall be bolt connected. Cabling materials and methods shall be used only in chases or concealed ceiling spaces.

PART 3 – EXECUTION

3.1 RESTRAINT GUIDELINE:

Guidelines for SMACNA seismic restraints for conduit, piping and ductwork are to serve as the basis for restraint methods. (Exception – Use rigid member bracing and attachment concepts. No cabling shall be used in the restraint systems except as noted.)

3.2 SEISMIC RESTRAINT-PIPING AND CONDUIT:

- A. General: All piping and conduit shall be protected in all planes by restraints, designed to accommodate thermal and physical movement. Tanks and vessels connected to piping shall be restrained in the same manner as the piping.
- B. Locations of the restraints shall include, but not be limited to:
 - 1. At all drops or risers to equipment connections.
 - 2. At all changes in direction of piping and conduit.
 - 3. At all horizontal runs of pipe and conduit to keep it in alignment and prevent sagging with restraints not to exceed the following:
 - Transverse bracing at 40'-0" O.C. maximum.
 - Longitudinal bracing at 80'-0" O.C. maximum.
 - 4. Provide flexibility in joints where pipes pass through building expansion joints.
 - 5. On both sides of flexible connectors.
- C. Exceptions:
 - 1. Conduit under 2-1/2" size and piping under 1-1/2" size need not be additionally seismically restrained except as follows:
 - a. Brace all piping and conduit 1-1/4" and larger electrical equipment rooms.

2. Seismic bracing may be omitted:

When the top of the pipe is suspended 12" or less from the supporting structure member and the pipe or conduit is suspended by an individual hanger. On all piping 3/4" and smaller.

3.3 **RESTRAINT OF INSULATED PIPING:** Where piping is designated to be insulated, the points of support shall be protected by a 360° sheet metal shield. Insert insulation shall be of the same thickness as the adjoining pipe insulation. The sheet metal shield provided shall be based on Pipe Shields, Inc. or Engineer approved equal.

The sheet metal shield wrapped around the insert shall be of the following lengths and gauge thickness.

PIPE SIZE	SHIELD LENGTH	MINIMUM GAUGE
1/2 - 1-1/2"	4"	20
2 - 6"	6"	20

3.1 **SEISMIC RESTRAINT - DUCTWORK:** Ductwork, four feet square and larger in cross sectional area or 26" diameter and larger shall be protected in all places by restraints. Locations shall include, but not be limited to:

- A. At all equipment connections.
- B. At all duct turns and duct run ends (transverse bracing).
- C. Transverse bracing to occur 30'-0" O.C. maximum. Rectangular ducts 61" and larger in either direction may be braced at 32'-0" O.C.
- D. Longitudinal bracing shall occur at 60'-0" O.C. maximum.

A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of restraint members.

No bracing is required if the top of the duct is suspended 12" or less from supporting member and attached to the top of the duct.

3.2 **VIBRATION ISOLATION:**

- A. General: Furnish and install devices to isolate moving equipment from the structure. (Or confirm that equipment may be securely fastened directly to the structure without negative effect.) Review isolation furnished with factory package equipment, require conformance with project criteria.
- B. Basic Criteria: Vibration isolation devices which have natural frequencies approximately 1/10 that of the related driving frequency.

C. Equipment to Include:

In-Line Ventilation Air Fan: Vibration isolated and seismically restrained.

Centrifugal Exhaust Fan:

D. Field Verify: All required devices and installation.

3.8 VIBRATION ISOLATION - DUCTWORK AND PIPING:

- A. Furnish and install devices to isolate all piping and ductwork from other moving equipment. Provide flex connections, spring hangers, grooved joint couplings for pipe, etc., as required.

END OF SECTION

SECTION 23 06 07
MOTORS, DRIVES & ELECTRICAL REQUIREMENTS

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 work of this section.
- B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division-26 and Division-40.
- C. Reference 26 29 23 for description related to Variable Frequency Drives (VFD)'s. All Variable Frequency Drives shall be furnished by Division 26.

1.2 SUMMARY:

- A. This section specifies the basic requirements for motors furnished by Division-23 HVAC and for electrical components which are an integral part of packaged HVAC equipment. Package components include, but are not limited to factory installed motors, starters, and disconnect switches, etc.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for HVAC equipment are noted within these documents.

1.3 QUALITY ASSURANCE:

- A. For items with electrical aspects furnished by this Division and these Sections, provide electrical components and materials which are UL labeled and assembled with U.L. listings.

1.4 SUBMITTALS:

- A. Submit product data for motors, belts, drives, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections. Verify project electrical characteristics with submittal. Confirm suitability for altitude, maintaining full nameplate rating plus service factor. Include this data in maintenance manual in accordance with 23 05 30 "HVAC Operation and Maintenance Manuals".

1.5 REFERENCES:

- A. NEMA Standards MG 1: Motors and Generators.
- B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standards 250: Enclosures for Electrical Equipment.
- D. NEMA Standards KS 1: Enclosed Switches.
- E. IEEE Standard 519: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

- F. Comply with National Electrical Code (NFPA 70).

PART 2 - PRODUCTS

2.1 MOTORS: See 26 05 74 "Electric Motors" but not less than the following:

- A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are given in the individual equipment specifications.
1. Torque characteristics shall be sufficient to satisfactorily accelerate and maintain the driven loads.
 2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
 3. Provide two-speed motors with two separate windings for poly-phase motors. Confirm 2-speed starter requirements with Division-26.
 4. Fraction Horsepower Single speed motors shall be of the permanent split capacitor type. (PSC)
 5. Temperature Rating: Minimum rate for 40°C environment with maximum 90°C temperature rise for continuous duty at full load (Class H Insulation for altitude, Class B leads allowed).
 6. Starting Capability: Capable of handling not less than 6 evenly timed/spaced starts per hour, (10 minute cycle time) or more as indicated by the automatic control system,
 7. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors, 1.0 for TEFC motors.
 8. Motor Construction: NEMA Standard MG 1, TEFC, continuous duty, design "B", except design "C" where required for high starting torque. Provide motors rated for "Inverter duty" where motors are fed power from variable frequency drives.
 9. Motor Frames: NEMA Standard No. 48 or 54; T-frame, use driven equipment manufacturer's standards to suit specific application.
 10. Bearings:
 - a. Ball or roller bearings with inner and outer shaft seals. Provide with electrically isolated bearings when the motor is fed power from a variable frequency drive.
 - b. Re-greasable with zerk fittings, except permanently sealed where motor is normally inaccessible for regular maintenance;
 - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust on motor;
 - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted;
 11. Enclosure Type: Totally enclosed fan cooled (TEFC) for wet or harsh/dirty environments. Typical throughout this project. Explosion proof (EP) rating for all

installation in hazardous locations.

12. Overload Protection: Provide motors with built-in thermal overload protection. Where indicated for industrial motor applications, Provide motors with an internal sensing device suitable for signaling and stopping motor at starter.
13. Noise Rating: "Quiet"
14. Efficiency: "Premium Energy Efficient" motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112. Motors used with Variable Frequency Drives shall be compatible and designed for use with Variable Frequency Drives. Any "explosion proof" motor set in a classified area and scheduled for use with a variable frequency drive shall be listed for inverter duty applications.
15. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
16. Acceptable Manufacturers: Allis-Chalmers, Baldor, Century, General Electric, Gould, Lincoln, Louis-Allis, Marathon, Reliance, U.S. Motors, Westinghouse.

2.2 MOTOR DRIVES:

- A. Provide fan/motor-compressor/motor drives with cast steel sheaves and V-belts of fabric and rubber construction by Browning, Dodge, or Woods. Match multiple belts and adjust the assembly to properly drive the apparatus and to prevent slippage and undue wear in starting. Design drives for 150 percent or more of the specified motor nameplate rating. Furnish all drives with shaft bushings. Belts shall be A, B or C section belts. Narrow gauge belts are not acceptable. Provide adjustable driver sheaves for motors five horsepower and smaller, adjust drives or replace sheaves (on larger motors) as needed to obtain required driven speeds and system capacities.
- B. Provide shaft to shaft coupled drives for pumps and blowers equivalent to the Dodge "Paraflex" design by Browning, Dodge or Woods.
- C. Provide a removable (for maintenance) galvanized steel guard for each V-belt drive, coupled drive or rotating shaft constructed around an angle iron frame, securely bolted to the floor or apparatus. Design the guard to completely enclose drives and pulleys and be constructed to comply with all safety requirements. Provide hinged access doors not less than 6" x 6" for access to motor and fan shaft for test purposes. For double inlet fans, construct the belt guard cover of 1/2" mesh expanded metal, arranged as not to restrict the air flow into the fan inlet.

2.3 VARIABLE FREQUENCY DRIVES: Reference 26 29 23.

END OF SECTION

**SECTION 23 09 00
HVAC CONTROL SYSTEMS**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23, Section 23 05 00 - General HVAC Requirements sections apply to work of this section.
- C. Division 40 is responsible for the overall instrumentation and control work for the exhaust fans. The HVAC systems are supportive of, but in many ways are independent of the fundamental process control aspects of the project. This section is an integration of the HVAC work into the overall plant instrumentation and control system.

1.2 SUMMARY:

- A. Extent of control systems work required by this section is indicated on “H” drawings and schedules, and by requirements of this section.
 - 1. This work has a multi-faceted HVAC Controls responsibility.
 - a. Provide Local Control Panels (LCPs) as described below to manage and control the HVAC devices and systems.
 - b. Controls for the stand alone HVAC related systems is to be provided by the Division 23 HVAC controls contractor using components described in this Section.
 - 2. Follow control sequences as described in these documents. It is common for sequences and set points to require adjustment in the field to accommodate the final character of overall assemblies. Allow time to make adaptations and adjustments as needed. System setups are often seasonally variable. Re-visit the operation at least four times during the first year to make sure that the functions of the systems are being satisfied.

3. During the bidding period, thoroughly review the documents and request clarification of insufficient, ambiguous or contradictory presentation. The fundamental assumption is that there is a duty to be met and that the documents require as a minimum that devices, materials and installation will be provided to result in fully coherent and functional systems. Provide devices with any and all optional features required to obtain required function. Provide devices of materials that are compatible with the plant environment.
- B. Refer to other Section 23 31 10 – “Ductwork Accessories” for installation dampers in mechanical systems.
- C. Refer to Division-26 sections for the following work.
 1. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.
 - a. Interlock wiring specified as factory-installed is work of this section.
- D. Provide all field electrical work complying with and as work of the Division-26 sections.
 1. Control wiring between field-installed equipment, controls, indicating devices, and unit control panels.
 2. 120 volt service required by instrumentation and control systems.
- E. Participate in Section 23 05 93 "Testing, Adjusting and Balancing".

1.3 QUALITY ASSURANCE:

- A. **MANUFACTURER'S QUALIFICATIONS:** Firms regularly engaged in manufacture of instrumentation and electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. **INSTALLER'S QUALIFICATIONS:** Firms and workmen specializing and experienced in programmable logic control, pneumatic and electric control system installations for not less than 5 years. Installer shall be under the direction of the instrumentation subcontractor and able to act as an authorized agent thereof.

1.4 SUBMITTALS:

- A. **PRODUCT DATA:** Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions. Confirm that devices offered are suitable for the indicated duty, inherently hardened against the adverse environment of the wastewater treatment plant. Note that exposed copper and copper bearing materials (i.e. bronze) are inappropriate for this duty. Provide devices of stainless steel, etc.
- B. **SHOP DRAWINGS:** Submit material catalog sheets and shop drawings for each control system, containing the following information:
 - 1. Schematic flow diagram of system showing, but not limited to, fans, unit heaters, coils, dampers and control devices, etc.
 - 2. Label each control device with final designated setting or adjustable range of control.
 - 3. Indicate all required tubing and/or electrical wiring. Clearly differentiate between portions of work that are factory-installed and portions to be field-installed. Note contract responsibility to provide complete system regardless of delegation. Completely interface with and show existing installation in the existing building.
 - 4. Provide details of faces of control panels, including controls, instruments, and labeling.
 - 5. Include verbal written description of sequence of operation. Confirm correct function of proposed sequences.
- C. **SAMPLES:** Submit sample of each type of proposed thermostat cover.
- D. **MAINTENANCE DATA:** Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Section 23 05 93.

1.5 REFERENCES:

- A. **CODES AND STANDARDS:**
 - 1. **Electrical Standards:** Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.
 - 2. **NEMA Compliance:** Comply with NEMA standards pertaining to

components and devices for electric control systems.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
4. Comply with NEPA 70, "National Electric Code" for all electrical installation.

1.6 DELIVERY, STORAGE, AND HANDLING: Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

1.7 INSTRUCTION OF OWNER'S PERSONNEL: (See Section 23 05 00)

- A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.
- B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.
- C. Prepare an outline of information to be conveyed, list materials available for reference. Submit to Engineer along with a proposed schedule of instruction. Schedule to allow individual time for each trade and each system.
- D. Convey information in formal classroom session. Teachers to include qualified contractor personnel and sales representatives for each major piece of equipment. Go from the classroom to the actual location to graphically illustrate concepts discussed.

1.8 WARRANTIES:

- A. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion not date of delivery).
- B. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.9 CLEANING AND LUBRICATION: All instruments, control panel and control piping shall be thoroughly cleaned before final acceptance. Provide lubrication for all furnished equipment.

1.10 TESTING AND ADJUSTING OF SYSTEM:

- A. During the system commissioning, testing and balancing of the various building systems, have a controls representative(s) present and available to interpret and

adjust controls as needed. Demonstrate and report the integrity and accuracy of each function and control point.

- B. At the termination of the testing period, the Controls representative shall spend one working day instructing the Owner's operating personnel in the control system operation, and one working day checking each system for day-night and manual override with the Owner's operating personnel on each air handling system. A complete operating booklet shall be provided and used during the training period. Schedule this training with the Owner and Mechanical Contractor.

Since system performance is partly a function of climatic conditions, the Controls contractor shall be available during the changing seasons of the warranty period to make further adjustments and modifications if required. A final complete check of all systems shall be made at the conclusion of the one year warranty period.

PART 2 - PRODUCTS

2.1 CONTROL CABINETS: Furnish weatherproof, stamped 316 stainless steel cabinets with hinged door(s) and locking latches by Hoffman or equal, to protect and conceal all power and control terminations for the air handling units, and independently for the local HVAC control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at terminal blocks. Provide engraved plastic labels for all panel face devices.

2.2 HVAC CONTROL DAMPERS:

- A. In supplying dampers, instruct the sheet metal ductwork (Section 23 31 00) workers in the proper installation of the dampers. Ductwork shall be reinforced and the damper properly supported at the point of insertion without strain.
- B. Protect (coat) all dampers mounted in a duct system which requires special treatment, or fabricate of Type 316 stainless steel.
- C. Provide damper operators with motors of proper size, so that the motors will operate against the static pressure of the systems. Provide each damper motor with a bracket for attaching to ductwork, building structure or equivalent. Damper motors in plenums shall be rigidly mounted on damper frames. Do not install motors in ducts. Modulating motors shall be provided with end switches and with integral stops for both minimum and maximum stop. Voltage ranges or pressure ranges shall be adjustable, the equivalent of pilot positioning for pneumatic or electric functions.

- D. Control dampers for handling of outside air, relief air, exhaust air, ventilating air and other dampers exposed to weather temperatures in built-up or factory assembled systems: shall be low leakage type with spring loaded side seals, inflatable butyl or neoprene fabric edge seals, nylon or teflon bearings, reinforced extruded blades. Parallel or opposed action. Air leakage not to exceed 10 CFM per square foot at 4" upstream static pressure. Where thin dampers are needed, or a narrow/thin vertical dimension is involved use 4" wide damper blades. In larger situations use 6" wide blades.

Provide dampers equivalent to Ruskin CD-40 (4") or Engineer approved equal by Greenheck, Cesco or Johnson Controls.

Provide actuators for control dampers with not less than 33% excess capacity over and above the minimum needed to drive a given damper, load at not more than 5 inch-lbs per square foot of damper, more if damper requires. Actuators shall be configured for the duty, typically modulating, explosion proof for rated areas, manual over-ride, dual end switches, 24 volt or 120 volt drive as indicated, on board choice of 2 – 10 volt DC or 4 – 20ma signal input, mounting bracket assemblies, jack shafting and adapters as needed.

Provide actuators equivalent to Belimo AF(SR) fully modulating, with end switches.

2.3 ROOM THERMOSTATS:

- A. The thermostats and controllers for the Unit Heaters and Split A/C Units shall be furnished by the respective vendors. Coordinate field wiring requirements with each vendor's installation instructions manual.

2.6 AUXILIARY RELAYS:

- A. Light Duty - as required. (verify current model number)
- B. Heavy Duty - Square D, Class 8501, Type X. (For motor control)

2.7 ACCESSORIES

- A. Provide devices with all components needed to make a complete and functional installation.

2.8 SOURCE QUALITY CONTROL

- A. Factory-calibrate each instrument according to manufacturer's standard at a facility that is traceable to the NIST.

- B. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 – CONTROL SEQUENCES AND EXECUTION

3.1 GENERAL:

- A. Provide control systems to manage and manipulate mechanical equipment in a functional and energy conserving way.
- B. Reference Division 40 for control sequences related to the exhaust fans under a separate contract.

3.2 ELECTRIC UNIT HEATERS (UH-1 & 2):

- A. Each electric unit heater cycles on its own controls to satisfy the heating set point temperature of 50°F (adj.) when activated by the local unit mounted or remote mounted thermostat.

3.3 ELECTRICAL ROOM COOLING (SHP-1):

- A. The Split System heat pump Unit operates through its own controls to maintain space temperature set point of 72° F (adj) in cooling mode and 50°F (adj) in heating mode. Furnish the unit with a remote-mounted wired thermostat.

3.4 SCREENING ROOM VENTILATION (REF-1, MD-1):

- A. Rooftop Exhaust Fan REF-1 is enabled to run whenever the building is occupied (with the lights) or when the space temperature exceeds the setpoint temperature of 85°F (adj).
- B. Motorized damper MD-1 is interlocked to open whenever Rooftop Exhaust Fan REF-1 is running,
- C. Reference electrical drawings.

END OF SECTION

SECTION 23 23 00 REFRIGERATION PIPING

PART 1 – GENERAL

1.1 GENERAL MECHANICAL REQUIREMENTS:

- A. All pertinent sections of Section 23 00 00 - General HVAC Requirements are a part of the work described in this section.
- B. All pertinent sections of Section 23 10 00 – General HVAC Pipes and Fittings are a part of the work described in this section.

1.2 SUMMARY:

- A. This section specifies:
 - 1. Piping, valves, specialties.
- B. Related Sections:
 - 1. Section 23 61 00 - Refrigerant Equipment.

1.3 STANDARDS:

- A. International Building Code/International Mechanical Code
- B. Local Codes and Ordinances
- C. EPA Requirements.
- D. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- E. ANSI/ASHRAE 90A - Energy Conservation in new Building Design.

1.4 SHOP DRAWINGS/SUBMITTALS:

- A. Submit a list of all materials to be used indicating brand or source, type and service.
- B. Submit shop drawings for all refrigerant piping, valves and specialties, including shop drawing showing proposed pipe routing, sizing, valving, etc.

1.5 CONTRACTOR QUALIFICATION:

- A. The Piping Contractor for this work shall be licensed as a firm in the Contractor state of origin and in the state of Utah.
- B. The Subcontractor shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Subcontractor.
- C. All workmen employed in the project shall carry state licenses as journeyman or

apprentice pipe fitters with additional certification for welders.

1.6 SCOPE OF THE WORK:

- A. Furnish and install all field fabricated refrigeration piping and related work to effect a complete installation.
 - 1. Piping, valves, specialties.
 - 2. Other refrigerant piping work indicated on the drawings.

1.7 INSTRUCTION OF OWNER'S PERSONNEL:

- A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.
- B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

1.8 WARRANTIES: See Section 23 05 00 "General HVAC Requirements".

PART 2 - PRODUCTS

2.1 PIPING MATERIALS: Piping materials shall be as follows unless otherwise indicated on the applicable contract drawing:

- A. Pipe: "ACR" Type L, hard drawing, degreased, sealed at mill copper tubing, ASTM B88-62, cleaned and sealed at the mill. Pre-charged refrigerant lines shall not be used.
- B. Fittings: Long radius, wrought copper type equal to Mueller Streamline, ASA B16.22.1963.

2.2 VALVES, SPECIALTIES, ETC:

- A. Filter-Dryer: On lines smaller than 3/4" O.D. filter-dryer shall be a sealed type using male flare fittings. Size shall be full line size. Filter-dryer shall be Sporlan, Mueller or Alco.
- B. Sight Glass: Shall be a combination moisture and liquid indicator with protection cap. Sight glass shall be Alco, Mueller, Sporlan or Henry. Size shall be full line size.
- C. Flexible Connection: Corrugated bronze hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for system working pressure.

- D. Solenoid Valve:
1. Valve: ARI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly with flared, solder, or threaded ends; for system working pressure. Stem shall permit manual operation in case of coil failure.
 2. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box 24 volt, confirm and coordinate with DDC controls.

2.3 REFRIGERANT AND LUBRICATING OIL: Furnish and install all of the refrigerant required to develop the system to its full rating, and in addition to the initial charge, provide, without cost to the Owner, all required refrigerant for the proper operation of the refrigeration apparatus during the first year's operation. The contractor shall be required to provide the initial charge of lubricating oil for all refrigeration apparatus and related equipment. Loss of refrigerant and oil during the first year of operation shall be made good at the contractor's expense.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. General: Use best practices of the trade in all installation. Installation shall conform to the American Standard Code for Pressure Piping, ASA B31.5-1962 Refrigeration Piping. Installed piping shall not interfere with the operation and accessibility of doors or windows; shall not encroach on aisles, passageways, and equipment; and shall not interfere with the servicing or maintenance of equipment. Pipe shall be cut accurately to measurements established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Cutting or weakening of structural members to facilitate piping installation is not permitted. Pipes shall have burrs removed by reaming and shall be so installed as to permit free expansion and contraction without damage to joints or hangers. Piping shall be installed in a straight manner, free from traps, and shall be provided with capped or plugged ends, as it is erected, to prevent dirt from entering the system. The piping system shall be provided with isolating hangers as required to prevent vibration of the compressor operation being carried to the building structure. The piping system shall be provided with gauges as required for the operation of the system, and the suction connection from each coil shall be provided with a test thermometer well in the pipe for adjustment of the thermostatic expansion valves.
- B. Slope of Refrigerant Lines: Slope suction lines down toward compressor 1" per 10 feet. Locate oil traps every 10 feet at all vertical rises against flow in suction lines. Suction line traps shall be standard one-piece traps.
- C. Cleanliness: All refrigerant lines and fittings shall be absolutely clean to avoid system operating difficulties and contamination. Use a good cleaning agent such as trichloroethylene.
- D. Joints:

Brazed joints: Cut tubing square and remove burrs. Clean both the inside of fittings and outside of tubing with steel wool, wire brush, or fine emery cloth before brazing.

Pass an inert gas (such as oil pumped dry nitrogen) through the copper piping when brazing joints to prevent formation of copper oxide. Take care to prevent annealing of fittings and tubing when making connections. Make up joints with silver bearing brazing material.

3.2 TESTING OF REFRIGERATION PIPING SYSTEM: After the installation of the refrigeration piping system has been completed and before insulation is applied, test all pipes and prove tight for a period of 24 hours, at a pressure of 300 pounds per square inch, using oil pumped dry nitrogen.

3.3 EVACUATION AND CHARGING: After completion of the piping pressure test, the refrigeration systems shall be evacuated and dehydrated using a vacuum pump capable of producing at least 1 mm Hg absolute. Use the following procedure unless otherwise directed:

Connect an accurate high vacuum gauge, such as Stokes or Zimmeril gauge to the system.

Connect the vacuum pump to both the high and low side of the system. Leave the compressor suction and discharge service valves closed. Start the vacuum pump.

Keep ambient air temperatures above 60° during the evacuation process.

Operate the vacuum pump until the system is evacuated to 2.5 mm Hg absolute.

Break the system vacuum with oil pumped dry nitrogen. Open the compressor suction and discharge service valves and re-evacuate the system to 2.5 mm Hg absolute.

After the system has been double evacuated to 2.5 mm Hg absolute, close the vacuum pump suction valve and stop the pump. Allow the system to stand under a vacuum a minimum of 12 hours. If no noticeable rise in pressure has taken place after 12 hours, the system may be charged. Make this test in the presence of the Owner's representative.

3.4 CLOSEOUT PROCEDURES:

A. Participate in Owner's Instruction.

END OF SECTION

SECTION 23 31 00 DUCTWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23 Basic HVAC Materials and Methods Sections apply to work of this section.

1.2 SUMMARY:

- A. Extent of metal and high density polypropylene ductwork is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork required for the project include the following:
 - 1. Underground Duct
 - 2. Rectangular
- C. Refer to Section 23 05 93 for system commissioning, testing and balancing.
- D. Refer to Section 23 09 00 for mechanical controls and control dampers (HVAC related only).
- E. Refer to Section 23 31 10 for ductwork accessories.
- F. Refer to Section 23 37 00 for louvers.
- G. Refer to Section 23 82 00 for power ventilators.
- H. Refer to Section 23 90 00 for filters.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal and high density polypropylene ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal and high density polypropylene ductwork systems work similar to that required for project.

The installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

All workmen on the project shall carry Utah state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for metal and high density polypropylene ductwork materials and products.
- B. Shop Drawings: Submit coordinated scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spacial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.
- C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division-1.
- D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division-1.

1.5 REFERENCES:

- A. Codes and Standards:
 - 1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
 - 2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.
 - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems".
 - 4. International Building Code/International Mechanical Code/equivalent Utah Codes: Comply with all sections pertaining to mechanical work.
- B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.6 DELIVERY, STORAGE, AND HANDLING:

- A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK - GENERAL:

- A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, HVAC Systems and Equipment, 2016 edition, Chapter 19, Duct Construction

2.2 SHEET METAL DUCTWORK:

- A. General: For all rectangular ductwork and fittings construct/fabricate from aluminum, PVC coated galvanized steel or stainless steel. Contractor may choose between aluminum, PVC coated galvanized steel or stainless steel except where specifically directed on the drawings.

If using galvanized sheet steel, provide galvanized sheet steel complying with ASTM A 527, lock forming quality, with G 120 zinc coating in accordance with ASTM A 525; mill phosphatized for exposed locations.

If using stainless steel, fabricate of Type 304 SS or Type 316 SS stainless steel sheet complying with ASTM A-167 with all welded joints and seams. Provide polished No. 4 satin finish for all duct exposed to view, No. 1 finish elsewhere. Protect finished surfaces with mill applied adhesive protective paper through fabrication and installation.

If using aluminum ductwork, aluminum ductwork shall be constructed of 3003-H-14 aluminum using construction for nominal 4" SMACNA rated systems. Seal all transverse joints with duct cement.

- B. Exposed Ductwork Materials: Provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Installation of exposed ductwork shall be laid out in advance and submitted for review. Ductwork shall be hung straight and uniform, points shall be true, and seams shall show continuity.
- C. Note a special requirement for hangers and supports for process areas. Project rejects strap hangers for ductwork. Make angle, insert, or clamp attachment to structure and hang suspended duct with rod or angle iron verticals and angle, channel or Unistrut horizontals. Brace and restrain ductwork as for piping with rigid assemblies. Do not use a cabling system for such duty.

2.3 UNDERGROUND DUCTWORK:

- A. Complete duct / piping system. Provide elbows, clamp & gasket, boots and caulk as required for a complete underground installation.
- B. Ductwork shall be of one of the following materials:
 - 1. Closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have integral R-10 equivalent thermal insulation value, without the use of external insulation, per NSF's P374 Protocol and

verified by a NSF Thermal Testing Report.

2. Pipe construction of an engineered compound of virgin and recycled high-density polyethylene conforming with the minimum requirements of cell classification 435420C (ESCR Test Condition B) as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. Fittings shall conform to ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of ASTM F2306.
 3. Rigid polyvinyl chloride (PVC) compound, Type 1 Grade 1, with a Cell Classification of 12454 as defined in ASTM D1784. Compound shall be white or gray in color and shall be approved by NSF International. Pipe shall be Schedule 40.
- C. All joints shall be sealed via gasket or bolts and sealant. Clamps and gaskets shall be used on ductwork without flanges. Clamps shall be polyethylene with stainless steel plates and stainless steel screws. Gaskets shall comprise of 1/4" thick butyl rubber sealant tape that is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.
 - D. Flanged joints shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.
 - E. Assembled ductwork shall be able to maintain pressure with no leakage.
 - F. Duct system shall be installed by the high density polypropylene (HDPE) ductwork manufacturer's trained installer.
 - G. Fiberglass style (FRP) ductwork or PVC coated galvanized steel ductwork shall NOT be acceptable.
 - H. Duct system performance shall exceed SMACNA's Leakage Class 3 requirements at the system design static pressure.
 - I. Duct system shall carry a 10 year Limited Warranty.
 - J. Acceptable Manufacturers: In compliance with requirements specified, provide HDPE ductwork by The Blue Duct or engineer prior approved equal by others.

2.4 FITTINGS AND FABRICATION:

- A. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section.
- B. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Duct Accessories" for accessory requirements.

- D. Offset, transition, and adapt ductwork to structural obstacles and work of other trades in a coordinated effort. Layout work to avoid conflict with piping, etc. With review of conditions, teardrop around conflicting piping, lights, etc., all at no added cost to the project.

2.3 MISCELLANEOUS DUCTWORK MATERIALS:

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Duct Sealing Compound for metal ductwork: Use a U.L. listed, fiber reinforced, water based adhesive duct sealing compound by Foster, Hard cast, United-McGill, Nova, Miracle, 3M, Duct mate, Duro Dyne. Verify that the material is listed for use in a moist, corrosive environment compatible with duct material. Follow manufacturer's directions for joint cleaning and preparation; seal all duct and plenum joints prior to and during assembly. Use mastics that will not weep if the duct is warmed above room temperature.

PART 3 – EXECUTION

3.1 INSPECTION:

- A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK:

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true to shape and to prevent buckling. Support vertical ducts at every floor.

All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be approved and installed as directed at project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering.

- B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

- C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- D. Electrical Equipment Spaces: Except as indicated, do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures. Maintain clearances above of and in front of electrical panels.
- E. Ducts at Structural and Architectural Penetrations: Where ducts are shown connecting to or passing through concrete, gypsum board, masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2-1/8" stainless steel angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Round high velocity ducts in vertical chases shall be supported with rolled angle rings. Close openings between duct and structure.
- F. Cross Breaking: Rectangular sheet metal ducts shall be cross broken or rolled rib reinforced on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid. Larger ducts shall include intermediate reinforcing angles or members to stiffen the panel faces.
- G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

Related to final installation cleanliness, damp wipe all ductwork on installation. Cap open duct ends, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

3.3 INSTALLATION OF UNDERGROUND DUCTWORK:

- A. Follow Installation Instructions provided by the HDPE ductwork manufacturer. It is strongly recommended to complete installation training provided by the HDPE ductwork manufacturer prior to installation.
- B. Excavate a trench evenly as per Installation Instructions. No bedding is required except for cases of bedrock or clay where sand or light aggregate may be used.
- C. Backfill material must consist of pea gravel or dry silica sand.

- D. The sealant and gasket material provided by the HDPE ductwork manufacturer must be used as directed. The use of non-approved sealant or gasket will void warranty.

3.4 HANGERS AND SUPPORTS FOR METAL DUCTWORK.

- A. It is essential that all ducts shall be rigidly supported. Hangers for low velocity ducts up to 18" in width shall be placed on not more than 10' centers.

Low velocity ducts 19" through 35" in width and greater shall be supported on not more than 5' centers. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.

- B. For rectangular ducts 36" and greater in width, construct hangers with all-thread rods and aluminum channel, galvanized iron channel, or Unistrut sections, minimum dimension 2" x 2" x 1/8".
- C. Ductwork Support Materials for ductwork in Process Areas: Provide 316 stainless steel fasteners, anchors, and rods, washers, nuts and provide 316 stainless steel or 6061-T6 aluminum alloy angles for support of ductwork in process areas. Do not use straps.
- D. Supporting Dampers: Parallel and opposed blade motor operated dampers shall be supported by reinforcing the ductwork or sheet metal walls at the damper locations to carry the weight of the dampers and the force exerted on the dampers due to air pressure, or shall be supported independent of ductwork from the ceiling or floor, as conditions at the site determine.

- 3.5 CONNECTIONS:** All duct joints, transverse and longitudinal, shall be made airtight by coating joints with duct sealing compound before joining, and then sealing the joint with one layer of "Glass Fab" reinforcing tape set in a coating of the compound. Tape and sealant shall not exceed a flame spread of 25 or a smoke development of 50.

- 3.6 WELDED JOINTS:** Welded metal ductwork shall have either an angle or a piece of 1/8" steel bar behind each weld to allow lying of a neat and continuous bead.

3.7 FIELD QUALITY CONTROL:

- A. Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away) shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. Repair leaks and repeat tests until total leakage conforms with Chart of Figure 4-1, Seal Class A, Leakage Class 3 for round/oval, 6 for rectangular.
- B. Allow 24 hours for the HDPE ductwork sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.

3.8 EQUIPMENT CONNECTION:

- A. General: Connect metal and high density polypropylene ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where indicated.

3.9 ADJUSTING AND CLEANING:

- A. Clean ductwork internally of dust and debris, as follows: With filters in place where applicable, operate the fans at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.
- B. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- C. Balancing:
 - 1. Refer to Section 23 05 93 section "Testing, Adjusting and Balancing" for air distribution balancing of metal or high density propylene ductwork; not work of this section. However, the Sheet Metal Contractor shall participate fully in this work. Seal any leaks in ductwork that become apparent in balancing process.
 - 2. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

END OF SECTION

**SECTION 23 31 10
DUCTWORK ACCESSORIES**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23 Basic HVAC Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

- A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork accessories required for project include the following:
 - 1. Control dampers.
 - 2. Duct hardware.
 - 3. Duct access doors.
 - 4. Flexible connections.
- C. Refer to 23 05 93 for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division-1.

1.5 REFERENCES:

- A. Codes and Standards:
 - 1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct

- Construction Standards, Metal and Flexible".
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
 3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
 4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.6 DELIVERY, STORAGE AND HANDLING:

- A. Protection: Protect shop-fabricated and factory-fabricated accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store accessories inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS:

- A. Control dampers are scheduled and furnished by 23 09 00 and installed by this Section. Dampers shall be supported, plenum openings shall be reinforced, and the entire assembly shall be sturdy and operate smoothly. Where mixing, install dampers to direct outside and return air into each other for mixing. Arrange for damper actuator mounting so that the actuator does not conflict with other functions.

2.3 DUCT HARDWARE:

- A. General: Provide duct hardware, typically of one manufacturer, for all items on project, for the following:
 1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, cover, for instrument tests. Ventlok No. 699 closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.
- B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
 1. Ventfabrics, Inc.
 2. Young Regulator Co.

2.4 DUCT ACCESS DOORS:

Doors shall of the same material as the ductwork, and be 2" narrower than the duct width by 18" up to a maximum of 24" x 18". Duct access doors shall be furnished for all filter sections. Provide double-wall doors with frames. Use two hinges or a full width piano hinge with one lock assembly for each 12" door width. Ventlok or Engineer approved equal.

2.5 FLEXIBLE CONNECTIONS:

- A. Extent of Work: Provide flexible connections between ductwork and equipment, such as at fan inlets and discharges, and at other places indicated on the drawings or called for by note or specification.
- B. Non-Corrosive Environment or Airstream: For system pressures up to 5" w.c, provide material of heavy waterproof woven glass fabric double coated with neoprene or Hypalon equivalent to "Ventglas" for interior locations and "Ventlon" for exterior locations, fabric not less than 3-1/4" wide clamped between strips of 24 gauge stainless steel or 20 gauge aluminum alloy. Material by Ventfabrics, Inc., Chicago, Ill.
- C. Corrosive Environments or Airstream: Provide material of heavy waterproof woven fiberglass fabric coated with Teflon equivalent to "Ventel" by Ventfabrics, Inc., Chicago, Ill.

By nature, the material is slippery and requires rigid clamping in the field installation. Install with the coated side to the corrosive air stream. Clamp the material into a stainless steel edging or hinge with a folded fabric edge. Be careful in securing the clamped fabric to the fan or duct as to not penetrate or disturb any protective coatings or surfaces.

PART 3 – EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES:

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- C. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL:

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

3.4 ADJUSTING AND CLEANING:

- A. Adjusting: Adjust ductwork accessories for proper settings

Label access doors in accordance with Division-23 section "Mechanical Identification".

Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

**SECTION 23 61 00
REFRIGERATION EQUIPMENT**

PART 1 - GENERAL

1.1 GENERAL MECHANICAL REQUIREMENTS:

- A. All pertinent sections of Section 23 05 00 - General HVAC Requirements are a part of the work described in this section.

1.2 SUMMARY:

- A. This section specifies:
 - 1. Split Heat Pump Systems

1.3 STANDARDS:

- A. Uniform Building Code/International Mechanical Code
- B. Local Codes and Ordinances
- C. State Pressure Vessel Regulations
- D. EPA Requirements.
- E. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- F. ANSI/ASHRAE 90A - Energy Conservation in new Building Design.
- G. ARI 370 - Sound Rating of Large Refrigeration and Air-conditioning Equipment.
- H. ARI 360 - Unitary Air-Conditioning Equipment.

1.4 SHOP DRAWINGS/SUBMITTALS:

- A. Submit a list of all materials to be used indicating brand or source, type and service.
- B. Submit shop drawings for all equipment including shop drawing showing proposed sizes, capacities, accessories, manufacturer and model numbers, wiring diagrams, etc.

1.5 CONTRACTOR QUALIFICATION:

- A. The Piping Contractor for this work shall be licensed as a firm in the Contractor state of origin and in the state where the work is performed.
- B. The Subcontractor shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Subcontractor.
- C. All workmen employed in the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

1.6 SCOPE OF THE WORK:

- A. Furnish and install all refrigeration equipment and related work to effect a complete installation.

1. Provide and install Refrigeration Equipment as indicated on the drawings.
2. Other work indicated on the drawings.

1.7 INSTRUCTION OF OWNER'S PERSONNEL:

- A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.
- B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

1.8 WARRANTIES: See Section 23 05 00.

PART 2 – MATERIALS AND METHODS

2.1 SPLIT SYSTEM HEAT PUMP UNITS (SHP-1):

- A. Extent of Work: Provide split type heat pump units, complete in all components as indicated on the drawings.
- B. Outdoor Units: Outdoor mounted, air cooled unit with hermetic or rotary compressor, air cooled coil and propeller type cooling fan.
 1. Cabinet: Cabinet shall be constructed of galvanized steel and finished with a baked enamel painting process. Unit access panels shall be removable and shall provide full access to all internal components.
 2. Fans: Outdoor fans shall be direct-drive propeller type with totally enclosed single phase motors with class B insulation and permanently lubricated sleeve bearings. Motor shall be protected by internal thermal overload protection.
 3. Compressor: Compressor shall be fully hermetic or scroll type compressor equipped with a complete oil system, operating oil charge and motor. Motor shall be equipped with internal overloads which protect the compressor from overtemperature and overcurrent. Scroll type compressors shall also be equipped with high discharge gas temperature protection.
 4. Outdoor Coil: Coil shall be constructed of seamless copper tubes mechanically bonded to aluminum fins.
 5. Refrigeration Circuit: Refrigerant circuit components shall include brass service valves and port connections, schrader type fittings with brass caps, accumulator, pressure relief, and a full charge of refrigerant.
 6. Safeties: The outdoor unit shall contain the following safety circuitry and components.
 - a. Time delay restart to prevent short cycling.

- b. Auto restart on power failure.
- c. High and low pressure switches.
- d. High pressure relief.
- e. Outdoor fan failure protection.

C. Indoor Fan Unit: Indoor ceiling mounted cassette direct expansion unit with forward curved fan, cooling coil all in one cabinet.

- 1. Cabinet: Cabinet components including supply and discharge grilles shall be fabricated from high impact polystyrene. Cabinet shall be thermally and acoustically insulated to improve performance. Cabinet shall be provided with a removable combination square supply air diffuser / return air grille assembly attached to the bottom of the cabinet.
- 2. Fans: Fans shall be fabricated of high impact polystyrene and shall be forward curved design for quiet operation. Fan motor shall be open drip proof permanently lubricated ball bearing type with inherent overload protection. Fan motors shall be 3 speed.
- 3. Coil: Coil shall be constructed of aluminum fins seamlessly bonded to copper tubes with galvanized steel tube sheets. A full length drip pan shall be provided.
- 4. Pump: Provide with internal condensate pump for draining of condensate.
- 5. Controls: Controls shall be microprocessor based and shall control space temperature, determine optimal fan speed, and run self-diagnostics. The unit shall provide the following minimum control functions.
 - a. Automatic reset function after power failure.
 - b. 24-hour timer cycle for system auto start/stop.
 - c. High discharge air temperature shutdown shall be provided.
 - d. Indoor coil freeze protection.
 - e. Wireless infrared remote control.
 - f. Fan only operation.
 - g. A time delay shall prevent compressor short cycling.

D. Approved Manufacturers:

- 1. LG
- 2. Carrier
- 3. Trane
- 4. Mitsubishi
- 5. Daikin

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR COOLED OUTDOOR UNITS:

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service.
- C. Install units on vibration isolation pad.
- D. Install units on concrete base as indicated.
- E. Provide connection to refrigeration piping system and evaporators.
- F. Manufacturer's Field Services
- G. Supply initial charge of refrigerant and oil for each refrigerant circuit.

3.2 INSTALLATION OF CEILING MOUNTED INDOOR AIR CONDITIONING UNITS:

- A. General: Install units where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordination: Coordinate with other work, including ceiling construction and electrical as necessary to interface installation of units with other work.
- C. Access: Provide access space around units for service as indicated, but in no case less than that recommended by the manufacturer.
- D. Support: Securely anchor units to the ceiling structure.
- E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
 - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- F. Piping Connections: Refer to Division-23 Piping sections. Provide connection to refrigeration piping system and outdoor condensing unit. Provide minimum 3/4" or line size (which ever size is greater) copper drain piping from each unit, extended to nearest floor drain. See plans for additional detail. Provide a vent and trap at each drain connection.
- G. Grounding: Provide positive equipment ground for ceiling mounted evaporative air conditioning unit components.

END OF SECTION

SECTION 23 76 00
TERMINAL ELECTRIC HEAT TRANSFER UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23 Motors Drives and Electrical Requirements for Mechanical Systems, General Mechanical Requirements, and General Pipes and Fittings sections apply to work of this section.

1.2 SUMMARY:

- A. Types of terminal units required for project include the following:
 - 1. Unit heaters, electric

PART 2 - PRODUCTS

2.1 EXPLOSION PROOF TYPE ELECTRIC UNIT HEATERS (UH-1 & 2):

- A. General: Provide explosion proof type electric unit heaters in location as indicated, and of capacities, and style and having accessories as scheduled.
- B. Units shall be complete factory assembled, wired and tested. Ready for installation and connection to electrical power source and control package.
- C. Unit heaters shall be rated for a Class I Division 1 environment.
- D. Unit heater cabinets shall be 14 gauge cold rolled steel, epoxy coated plated fan guard shall have less than 1/4 inch spacing to conform with OSHA requirements. All fasteners shall be zinc plated. Heater conduits shall be cadmium plated seamless steel or aluminum.
- E. Heat exchangers shall be heavy walled, liquid filled, with three, low watt density, immersion type copper sheathed elements hermetically sealed into the core along with the high limit thermal cut-out. Heat transfer fluid shall be ethylene-glycol solution protected to -49°F. Single point power connection. Furnish with heavy duty hanging bracket.
- F. Motors shall be PSC, explosion-proof, permanently lubricated, ball bearing type, 1725 RPM.
- G. Contactors shall be built-in and pre-wired into an explosion proof enclosure.

Contactors shall be heavy duty and break all ungrounded conductors and be rated for 100,000 cycles at full load. Control transformers shall be built-in and pre-wired. Control circuits shall be 24 volt.

Provide with automatic temperature controls built into unit with integral explosion proof thermostat, 40 degree to 100 degree temperature range, three position explosion proof switch wired to control for on, standby and fan only settings, indicating light for when heating elements are energized.

H. Manufacturer: Subject to compliance with requirements, provide explosion proof electric unit heaters of one of the following:

1. Markel
2. Reznor
3. Indeeco
4. Ruffneck
5. Q-Mark

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION OF TERMINAL HEAT TRANSFER UNITS:

- A. General: Install heaters as indicated, and in accordance with manufacturer's installation instructions.
- B. Locate heaters where indicated.
- C. Provide and install hangers and supports for heater. Support heater independently from the roof or wall structure.

3.3 ELECTRICAL WIRING:

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted.

3.4 ADJUSTING AND CLEANING:

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
- B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

**SECTION 23 82 00
POWER VENTILATORS**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23 General Mechanical Requirements sections apply to work of this section.
- C. See Section 23 06 07 Motors, Drives and Electrical Requirements for Mechanical Work.

1.2 SUMMARY:

- A. Extent of power and gravity ventilator work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of power and gravity ventilators specified in this section include the following:
 - 1. Centrifugal Rooftop Mounted Exhaust Fan.
- C. Refer to Division 23, Section 23 05 93 "System Commissioning, Testing and Balancing" for balancing of power and gravity ventilators; not work of this section.
- D. Refer to Division-23 and 40 temperature control and instrumentation systems sections for control work required in conjunction with power and gravity ventilators; not work of this section.
- E. Refer to Division-26 sections for the following work; not work of this section.
 - 1. Power supply wiring from power source to power connection on ventilators. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory installed, by manufacturer.
 - 2. Interlock wiring between ventilators; and between ventilators and field installed control devices as shown in Division-26.

Interlock wiring specified as factory installed is work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of power and gravity ventilators, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.
- B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
- D. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division-23.

1.5 REFERENCES:

- A. Codes and Standards:
 - 1. AMCA Compliance: Provide power ventilators which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Rating Seal.
 - 2. UL Compliance: Provide power ventilators which are listed by UL and have UL label affixed.
 - 3. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.

PART 2 - PRODUCTS

2.1 ROOFTOP MOUNTED CENTRIFUGAL EXHAUST FAN (DW-REF-1):

- A. General: Fans shall be spun aluminum, curb mounted, belt driven, horizontal or vertical flow, with air flow capacity as scheduled, centrifugal exhaust ventilator.
- B. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance. Fan shall be rated for a Class I, Division I environment and provided with a phenolic coating for all components exposed to the airstream.
- C. The fans shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
- D. Fans shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure.

- E. Provide fans with a wind band or discharge baffle having a rolled bead for added strength.
- F. Provide fans with a two piece cap having stainless steel quick release latches to provide access into the motor compartment without the use of tools.
- G. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections.
- H. The motor, bearings and drive shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust air stream. Lifting lugs shall be provided to help prevent damage from improper lifting.
- I. The fan wheels shall be non-sparking centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic inlet cone. Wheel shall be statically and dynamically balanced in accordance with AMCA Standard 204-96.
- J. The motor shall be an electronically commutated motor rated for continuous duty and furnished with an internally mounted potentiometer speed controller.
- K. Accessories:
 - 1. Provide fans with galvanized wire insect screen on fan outlets.
- L. Manufacturer: Subject to compliance with requirements, provide wall mounted centrifugal exhaust fans of one of the following:
 - 2. Acme
 - 3. Cook
 - 4. Pace
 - 5. Greenheck
 - 6. Penn
 - 7. Twin-City

PART 3 - GENERAL

3.1 INSPECTION:

- A. General: Examine areas and conditions under which power ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER VENTILATORS AND FANS:

- A. General: Except as otherwise indicated or specified, install power ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that products serve the intended function.

- B. Coordinate ventilator work with work of roofs, walls and ceilings, as necessary for proper interfacing.
- C. Ductwork: Refer to Divisions-23 sections 23 31 00 "Ductwork" and 23 31 10 "Ductwork Accessories." Connect ducts to ventilators in accordance with manufacturer's installation instructions.
- D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted.
- E. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

3.3 FIELD QUALITY CONTROL:

- A. Testing: After installation ventilators have been completed, test each ventilator to demonstrate proper operation of unit at performance requirements specified. When possible, field correct malfunctioning units, and then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.4 ADJUSTING AND CLEANING:

- A. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

**SECTION 23 90 00
AIR FILTERS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-23, Section 23 05 00 General HVAC Requirements sections apply to work of this section.

1.2 SUMMARY:

- A. Extent of air cleaning work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of air cleaning equipment specified in this section include the following:
 - 1. Filter Holding Systems.
 - a. Side Servicing Housings.
 - b. Filter Face Access Housings.
 - 2. Air Filters.
 - a. Replaceable (throwaway). Type 1.
 - b. Extended surface self-supporting. Type 2.
 - 3. Filter Gages.
- C. Refer to Division-23 duct accessories section for duct access door work required in conjunction with air filters; not work of this section.

1.3 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air cleaning equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data including, dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for filter rack assemblies indicating dimensions, materials, and methods of assembly of components.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of filter

and rack required. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division-23.

1.5 REFERENCES:

A. Codes and Standards:

1. UL Compliance: Comply with UL Standards pertaining to safety performance of air filter units.
2. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing, and for recording and calculating air flow rates.
3. ARI Compliance: Comply with provisions of ARI Standard 850 pertaining to test and performance of air filter units.

PART 2 - PRODUCTS

2.1 AIR FILTERS:

A. Manufacturers: Subject to compliance with requirements, replaceable filter media and holding frames shall be a product of one of the following:

1. American Air Filter
2. Continental
3. Farr

B. Holding Frames: Suitable for filters specified. Frame and brace into solid assemblies.

1. May be side access, factory fabricated type.

C. Type 1: Replaceable flat media.

1. Flat panel non-woven filter fabric in a cardboard holding frame, 2" thick. .26" s.p. initial pressure drop, to change out at 0.50", 20% average efficiency on 85% average arrestance on ASHRAE Test 52-76.
2. Equivalent to Farr 20/20 series, or 2" thick fiberglass in cardboard frame.

D. Type 2: Replaceable pleated media type filters.

1. Pleated, medium efficiency in a cardboard holding frame, 2" or 4" thick as scheduled, 0.32" s.p. maximum initial pressure drop at 500 feet/minute, to change out at 0.50". U.L. Class 2, 25-30% efficiency, 90-95% arrestance per ASHRAE Standard 52-76. Typical selection for 300 feet/min, or less.
2. Equivalent to Farr 30/30.

E. Filter Gauges:

1. Inclined tube manometer, oil filled type equivalent to Dwyer 250-AF. 0-1" range for flat filters, 0-3" range for high efficiency rigid or lag filters, other gauges to match filter

range, or use Magnehelic gauges similar range.

2. Furnish with mounting bracket, pressure tips, tubing vent/zero valves.

F. Startup Set:

1. Install a set of Type 1 filters immediately upon fabrication of any filter bank. Install scheduled set of filters at completion of construction at the time of testing and balancing.

G. Replacement Set:

1. Furnish a second set of filters for each unit to be turned over to Owner as initial replacement stock.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air filters and filter housings will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION:

A. General: Comply with installation requirements as specified elsewhere in these specifications pertaining to air filters housing/casings, and associated supporting devices.

B. Install air filters and holding devices of types indicated, and where shown; in accordance with air filter manufacturer's written instructions and with recognized industry practices; to ensure that filters comply with requirements and serve intended purposes.

C. Locate each filter unit accurately in position indicated, in relation to other work. Position unit with sufficient clearance for normal service and maintenance. Anchor filter holding frames securely to substrate.

D. Coordinate with other work including ductwork and air handling unit work, as necessary to interface installation of filters properly with other work.

E. Install filters in proper position to prevent passage of unfiltered air.

F. Install air filter gage pressure tips upstream and downstream of filters to indicate air pressure drop through air filter. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level inclined gages if any, for proper readings.

3.3 FIELD QUALITY CONTROL:

A. Operate installed air filters to demonstrate compliance with requirements. Test for air leakage of unfiltered air while system is operating. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.

END OF SECTION

**SECTION 26 05 00
ELECTRICAL GENERAL REQUIREMENTS**

PART 1 - GENERAL

1.1 SCOPE

- A. This Section consists of the Electrical General Requirements and related items necessary to provide complete and operational electrical system(s) indicated within the Contract Documents.

1.2 APPLICABLE SECTIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions, Special Conditions, Alternates and Addenda, applicable drawings, and the technical specifications herein shall apply to all work under this Division 26.
- B. The CONTRACTOR shall comply with the specifications and accompanying drawings which describe and provide for the furnishing, delivering, installing, testing, and placing in satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete electrical system for power distribution, control, lighting, and auxiliary systems.
- C. State Licensed Contractor - All contractors must have a current state contracting license. The CONTRACTOR shall be licensed as such in the CONTRACTOR state of origin and in the state where the work is performed.
- D. The electrical contractor shall have a licensed Master Electrician assigned to direct the electrical work and to coordinate work with the General Contractor and other trades. Furthermore, a licensed journeyman electrician shall be assigned to supervise the actual performance of all electrical work under Division 26.
- E. The licensed journeyman assigned to supervise the performance of Division 26 electrical work, shall be required to be on the job site at all times, while Division 26 work is being performed.

1.3 CONTRACT DOCUMENTS

- A. Contract documents consist of drawings, specifications, and other documents issued by the ENGINEER. Each is complementary and requirements shown, written or reasonably inferred there from on one is considered as written, shown or implied in all. In the event work is called for in more than one place and is of conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.

- B. The drawings are diagrammatic, intended to indicate the general scope and locations of the work to be installed and are not to be considered as complete in every detail, but shall be followed as closely as actual construction and work of other contractors will permit.
- C. Data given herein and on drawings are as exact as could be secured, but their extreme accuracy is not guaranteed. Drawings and specifications are for the assistance and guidance of the CONTRACTOR; but exact locations, distances, and levels will be governed by actual conditions, and the CONTRACTOR is to verify all dimensions given on the drawings, and to report any discrepancy or inconsistency to the ENGINEER before commencing with the work.
- D. The CONTRACTOR shall install all work indicated and/or specified herein, complete to perform the function intended without additional cost. Raceway and conductors to panels from devices referred to as "home runs" are indicated by pointing in the general direction of panels. Construction shall continue such circuits to the panels as though the routes were completely indicated. Home runs shall be installed from devices to panels as indicated.
- E. Deviations from the drawings required to make work of this contract conform to actual conditions as constructed, or as to work of other contractors, shall be made by the CONTRACTOR at his expense. The ENGINEER reserves the right to make minor changes in the location of equipment and devices without additional charges.
- F. The CONTRACTOR shall familiarize himself with the architectural, structural, and civil/mechanical drawings and shall study drawings and details so that equipment will be properly located and readily accessible. If any conflicts occur necessitating departures from the contract drawings, details of departures and reasons therefore shall be submitted for prior approval.
- G. In any case and at any time, a change in material or location is made necessary by CONTRACTOR's failure to take into account obstacles or the installation of other trades shown, whether on electrical drawings or other drawings, in existence at the time bids were received, such changes shall be made without charge to OWNER.
- H. Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by the CONTRACTOR, Shop Drawings of various contractors shall be coordinated to take into account all obstacles that will interfere with the installation.

- I. Every attempt has been made to indicate the installation and wiring requirements for all equipment to be installed. However, it shall be the CONTRACTOR's responsibility to coordinate with equipment shop drawings and make adjustments necessary including; power and control wiring sizes and counts, breaker sizes, rough-in locations, etc. for actual equipment provided. The contractor shall provide in his bid the conductors and conduits required for the equipment to be installed. The contractor shall reference the mechanical drawings, the P&ID drawings, the control diagrams, the control drawings, the power drawings, the one line diagrams and all schedules. The contractor shall at his expense provide the conduit and conductors for the equipment installation for a complete and functional system.
- J. Every attempt has been made in the drawings to indicate the general installation requirements for the power and control connections for the equipment indicated. However, equipment requirements vary from manufacturer to manufacturer and from date to date for equipment. The responsibility to coordinate the exact requirements of all equipment and install the required systems for these systems shall belong to the contractor, at his expense. No additional costs to the owner shall be incurred for the contractor's failure to coordinate these equipment requirements at the time of bid.
- K. Electrical drawings are diagrammatic in nature and are not intended to show shop drawing style connections, equipment installation coordination or exact conduit and conductor sizes or counts. The contractor shall at his expense coordinate and provide necessary electrical and control components for a complete and functional system. If any conduit, equipment schedule, sizing, capacities, counts, lengths are unclear at the time of bidding or if conflicts exist on the drawings or in the specifications, the owner reserves the right for the installation of the more expensive or the more involved at no additional cost to the owner.

1.4 INFORMATION FOR ENGINEER

- A. Submit the required information in accordance with the General Conditions, Section 01300, and the following requirements.
 - 1. The CONTRACTOR shall check all shop drawings for conformance with Contract Documents before submitting. The CONTRACTOR shall note on shop drawings any changes from items specified listing reasons and giving source of change such as "Approved Equal", "Addendum", or "Change Order". The CONTRACTOR shall be responsible for conformance with drawings and specifications; for dimensions to be confirmed and correlated at the job site: for information that pertains solely to the fabrication processes or the techniques for construction; and coordination of the work with other trades. Receipt or approval of shop drawings by the ENGINEER does not relieve the CONTRACTOR of the responsibility of complying with Contract Documents.

2. All shop drawings (drawings and manufacturer's data) required under each section of this Division 26 shall be submitted at the same time and be bound together in one hard back, three ring binders per copy, properly indexed for the formal submittal. Binder shall be sized to adequately contain all the materials therein and shall be labeled as to the identity of the job and the sub-contractor.
 3. Shop drawings shall include functional and descriptive literature of the particular item furnished complete with dimensional drawings, wiring or schematic diagrams, rough-in and installation instructions, knock-out locations, hangers or mounting devices, etc., as required for the proper checking and installation of the equipment. Catalog sheets without any reference made to the particular item will not be acceptable. All special features called for in Contract Documents shall be noted. Where performance test results of a product design are called for in the technical sections of these specifications, test data sheets shall be provided with the shop drawing submittal.
- B. Material Lists: Include manufacturer, type and model number of equipment that will be provided as called for under each section of this Division 26.
- C. Other Information: As required by the ENGINEER.

1.5 CODES, LICENSES AND STANDARDS

- A. Perform work in accordance with best present-day installation and manufacturing practices. Comply with all applicable laws, building and construction codes, and requirements of governmental agencies under whose jurisdiction work is being performed. Unless specifically noted to contrary, conform with and test in accordance with applicable sections of latest revisions of the following codes and standards.
1. American Society for Testing and Materials (ASTM)
 2. National Fire Protection Association (NFPA)
 3. National Electrical Code (NFPA 70-NEC)
 4. Insulated Power Cable Engineers Association (ICEA)
 5. Underwriters Laboratories Inc. (UL)
 6. American Steel and Iron Institute, "Design Manual on Steel Electrical Raceways"
 7. National Electrical Manufacturer's Association (NEMA)
 8. National Electrical Contractor's Association (NECA)
 9. American National Standards Institute (ANSI)
 10. International Building Code (IBC)
 11. State of Nevada Electrical, Energy, Building and Safety Codes
 12. Institute of Electrical and Electronic Engineers (IEEE)

13. Instrument Society of America

14. Wastewater Treatment Plants (NFPA-820)

- B. Conflicts Between Above Codes and Standards: The code or standard establishing the more stringent requirements shall be followed.
- C. Conflicts Between Codes and Standards and Specifications and/or Drawings: The one establishing the more stringent requirements shall be followed.

1.6 MATERIALS AND WORKMANSHIP

- A. Each type of equipment or material shall be the same make and quality. All materials and equipment shall be installed in accordance with the recommendations of the manufacturer as approved by the ENGINEER to conform to the Contract Documents. The installation shall be accomplished by workmen skilled in the type of work involved.
- B. All materials and equipment furnished and installed shall be of best quality, new, free from defects and meet the standards of NEMA, ICEA, UL, NFPA, IBC, OSHA, NEC, and shall bear their label wherever standards have been established and label service is available. Where materials and equipment are specified by manufacturer's name, the type and quality required is thereby denoted. The ENGINEER shall be afforded every facility, deemed necessary to observe and examine the materials and apparatus being installed to prove their quality.
- C. Workmanship shall be the best quality of its kind for the respective industry crafts and practices, be neat and orderly throughout the project and shall be acceptable in every respect to the ENGINEER. Nothing contained herein shall relieve the CONTRACTOR from making good and perfect work in all details of construction.
- D. The CONTRACTOR shall work in harmony with the ENGINEER and with other contractor's, companies or individuals working in connection with this project. Imperfections or discrepancies by other contractors shall not relieve responsibility of this CONTRACTOR. Store materials orderly and clean up without interference with other trades.

1.7 DEFECTIVE EQUIPMENT

- A. If equipment fails to conform to detailed specifications or to operate satisfactorily, the OWNER will have the right to operate equipment until defects are corrected.
 - 1. The OWNER will have the right to operate rejected equipment until it is replaced, without cost for depreciation use or wear.
 - 2. Remove equipment from operation for examination, adjustment, alteration or change only at times approved by the OWNER.

1.8 STORAGE AND PROTECTION OF MATERIALS

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work under way, and apparatus against loss or damage.
- B. Materials and apparatus shall be stored with environmental protection and other necessary conditions as recommend or required by the manufacturers’.

1.9 RECORD DRAWINGS

- A. The Contract Document drawings will be used by the CONTRACTOR who shall accurately and neatly mark in colored pencil all changes or deviations from the drawings as they are made in the work.
- B. Refer to Section 01 70 00 Closeout Procedures and Record Drawings for additional requirements.

1.10 COORDINATION OF CONSTRUCTION

- A. Coordinate work with other contractors, the OWNER, and the ENGINEER to assure orderly and expeditious progress of work. Select order of work and establish schedule of working hours for construction. This is subject to review by the OWNER if the work involved is part of a functioning facility. If such is the case, the CONTRACTOR shall carefully coordinate any disruption of service with the OWNER. Any after hours/weekend outages shall be accommodated at no additional cost to the OWNER.
- B. The electrical work shall be laid out in advance of construction to eliminate unnecessary cutting, drilling, or channeling, etc. Where such cutting and drilling, or channeling becomes necessary for proper installation; perform with care, use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the OWNER. Cutting work of other trades shall be done only with the consent of the CONTRACTOR. Cutting of structural members shall be done only with the written approval of the ENGINEER.
- C. Comply with the following:
 - 1. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 2. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 - 3. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

- D. Cooperate with other trades to coordinate locations of electrical devices and apparatus.
- E. Perform for other trades the electrical wiring and connections, for all devices or apparatus where not specified herein or indicated on the drawings. Consult the architectural and mechanical drawings to avoid the location of switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc. Hidden electrical devices and/or connections shall be relocated as directed, at no additional cost to the OWNER.
- F. Where conduit, outlets or apparatus is to be cast in concrete or encased, it must be located and secured by a journeyman or foreman present at the point of installation. He shall check the locations of the electrical items before and after the concrete and masonry installation and shall relocate displaced items at no additional cost

1.11 USE OF SUBSTITUTES

- A. Equipment and materials are designated by one or more manufacturer's name brands or numbers. It is not the intent of the specifications to exclude other equipment or materials that equal or exceed the standard of those specified. If the CONTRACTOR desires to use substitute equipment or materials, he must submit for written approval as outlined in the General Conditions of the Contract Documents.

1.12 SITE CONDITIONS

- A. Examination Of Site: Examination of the site shall be made by the CONTRACTOR, who shall compare it with the drawings and specifications and satisfy himself as to the conditions under which the work is to be performed. He shall, at such time, ascertain and check all conditions which may affect his work. No allowance shall subsequently be made in his behalf for any extra expenses to which he may be put due to failure or neglect on his part to make such examination.
- B. Review of Plans: Review all work indicated on drawings and specified herein with proper authorities responsible for interpreting applicable codes, ENGINEER, and local inspector prior to commencement with construction as listed herein, but not necessarily limited thereto:
 - 1. Visit site prior to executing bid.
 - 2. Verify measurements and locations of field measurements of existing conditions and those developed by construction.
 - 3. Confirm requirements of work at off-site, publicly owned property with local authorities
 - 4. Confirm connection requirements, sizes and layout with local public utilities.

5. Conditions discovered in conflict with intent of drawings and/or specifications must be clarified with ENGINEER prior to execution of work.

1.13 CLEAN-UP

- A. As the work progresses and on a daily basis, the CONTRACTOR shall remove from the premises and surrounding streets, alleys, etc., all rubbish and debris resulting from his operations and shall leave all equipment and material furnished by him absolutely clean and ready for use.

1.14 SUPERVISION:

- A. A competent foreman or superintendent initially approved by the ENGINEER shall be at the site at all times to receive instructions and shall be empowered to act. He shall verify dimensions given on the drawings and report any discrepancies or inconsistencies to the ENGINEER before commencing the work. The ENGINEER, or his representative, will interpret the meaning of the drawings and specifications where questions arise.

1.15 SAFETY REGULATIONS

- A. The CONTRACTOR shall comply with OSHA and all other safety codes required by law and shall furnish and place proper protection for prevention of accidents. He/she shall provide and maintain any necessary construction required to secure safety of life or property during the performance of his/her work, including the maintenance of sufficient lights to secure such protection.

1.16 DISPOSITION OF EXISTING EQUIPMENT REMOVED FROM SERVICE

- A. Existing equipment and materials such as cables, switches, conductors, etc., which are removed and not reused in the new installation shall remain the property of the OWNER. The CONTRACTOR shall deliver such equipment to storage place as directed. Items not wanted by the OWNER shall be removed from the site and disposed of by the CONTRACTOR.

1.17 PERMITS AND FEES

- A. Obtain all permits and pay all fees for inspections, required by code for all the work covered under Division 26 of the specifications. All fees shall be included in the contract price. The CONTRACTOR shall furnish a certificate of approval to the ENGINEER from each inspection authority at completion of the work.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 FIELD DESIGN CHANGES

- A. No field changes, additions, or change in locations shall be made without written approval from the ENGINEER.

3.2 EXCAVATION AND BACKFILLING

- A. The CONTRACTOR shall perform all excavation, trenching and backfilling work, and remove all debris in connection with his work. Backfilling shall be done with materials acceptable to the ENGINEER and thoroughly tamped in place. All disturbed surfaces shall be restored to their original condition and properly installed to eliminate any settlement. Inside and outside, backfill shall be in 6-inch layers, compacted to 95% of the "standard protector test".
- B. Perform excavation in a manner to protect walls, footings and other structural members, from being disturbed or damaged in any way.

3.3 ROUGH-IN REQUIREMENTS

- A. Architectural, structural and mechanical drawings shall be continually consulted and referred to. Exact placement of sleeves, conduit, and equipment shall be provided for by checking building and equipment dimensions. Equipment requirements and dimensions related there to shall be determined from detailed rough-in dimensions of each piece of equipment shown on Shop Drawings furnished by manufacturer.

3.4 CUTTING AND PATCHING CHASES AND OPENINGS

- A. Provide for all required cutting and patching, anchors, openings, slots, chases, etc., in construction for electrical work. Cutting and patching performed under direction of CONTRACTOR and will leave no discernable scars.
- B. The CONTRACTOR shall be responsible for block-outs or demolition work pertaining to the installation of the electrical system.
- C. In Remodeling and/or Addition projects, all salvageable electrical equipment and materials that cannot be integrated into the new electrical network becomes the property of the OWNER. Remove from the premises materials which the OWNER decides not to keep, as directed by the ENGINEER.

3.5 WORKMANSHIP

- A. The CONTRACTOR shall be held solely responsible for the proper installation of his work. He shall arrange with the proper contractors for the building in of anchors, etc., and for the leaving of required chases, openings, etc., and shall do all cutting and patching made necessary by his failure or neglect to make such arrangements with others. Any cutting or patching done by this CONTRACTOR shall be subject to the directions of the ENGINEER and shall not be started until approval has been obtained.
- B. All cutting, welding or drilling of concrete or structural members shall be properly reinforced and patched to match as nearly as possible the surrounding work. Before cutting, welding or drilling any concrete or structural member, the CONTRACTOR shall secure the approval of the ENGINEER.
- C. This CONTRACTOR shall assign persons in direct charge of work who are thoroughly experienced in the class of construction work specified herein. All labor shall be performed in a workman like manner by skilled workmen under the supervision of competent foremen.
- D. This CONTRACTOR shall periodically remove all debris and waste in order to maintain safe working and operating conditions, and shall dispose of the same in an approved manner. At the completion of work, he shall remove all his rubbish, tools, scaffolds and surplus materials from and about the site, leaving his work clean and the areas ready for occupancy.

3.6 SEISMIC RESTRAINT

- A. The International Building Code requires that not only the structure, but also major mechanical and electrical components be designed and installed in a manner which will preclude damage during a seismic event. All electrical equipment shall be securely anchored and seismic braced in accordance with regulations contained in the most recent adopted edition of the IBC, and SMACNA "Guidelines for Seismic Restraints of Electrical Systems".
- B. Units mounted and secured directly to structure shall be provided with connectors of sufficient strength to meet the restraining criteria.
- C. All electrical equipment which is securely anchored (hard mounted) to the building or structure shall have supports designed to withstand lateral and vertical "G" loadings equal to or greater than IBC requirements and SMACNA guidelines.

- D. Shop drawings are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, load/deflection data, center of gravity, standard connections, manufacturer's recommendations, and behavior problems (vibration, thermal, expansion, etc.) associated with equipment so that the final design can be properly reviewed.

3.7 TESTS

- A. On completion of the work, the installation shall be tested free from all grounds and short circuits.
- B. Normal feeders, circuits, and service entrance conductors with wire size #2 and larger shall be tested for leakage phase-to-ground and phase-to-phase prior to energizing the electrical system. The CONTRACTOR shall submit a written report to the ENGINEER showing methods and readings taken. Voltage applied for testing shall not exceed two times normal operating voltage.
- C. Submit a record of voltage readings and amp meter readings on all feeders, motor full load amps, outside lighting, and service conductors to the facility. If there are any abnormal conditions, they shall be brought to the attention of the ENGINEER in writing as a part of this submittal.
- D. Refer to Section 26 05 08 Electrical Acceptance Tests for additional requirements.

3.8 SUBSTANTIAL AND FINAL COMPLETION

- A. Notify the ENGINEER when work is considered to be complete, in operating condition, and ready for Substantial Completion.
- B. The ENGINEER, after determining that installation is ready for Substantial Completion, will make walkthrough and perform operational tests deemed necessary to determine that provisions of specifications are satisfied and prepare a list of outstanding items.
- C. The OWNER will not accept work nor make final payment to CONTRACTOR until ENGINEER has certified that work of CONTRACTOR is complete and in conformance with specifications and guarantees.
- D. Leave the job in complete order ready for use. All fixtures and equipment shall be tight, fully equipped and completely cleaned. All equipment shall have been operated, checked and approved by the OWNER before the project can be accepted.
- E. At the time of the substantial and final walkthroughs, the project foreman shall accompany the party and remove cover plates, panel and enclosure covers, and other access panels for the ENGINEER, to allow complete observation of the entire electrical system(s).

- F. Notify the ENGINEER when work is considered to be complete, including list of outstanding items, and is ready for Final Completion. Refer to Section 01 70 00 Closeout Procedures and Record Documents for additional requirements.

3.9 TRAINING

- A. Instruct OWNER's operating personnel in proper operation of the complete electrical system including all electrical equipment, switching, disconnects, panels, controls, etc., during a scheduled training tour for the OWNER's personnel of entire project after Substantial Completion and prior to Final Completion. Confirm complete understanding on part of OWNER's operating personnel. Utilize the Operations and Maintenance Manuals specified elsewhere during the instruction process.

3.10 GUARANTEE/WARRANTY

- A. The following guarantee is a part of the specification and shall be binding on the part of the CONTRACTOR and shall be submitted by letter to the OWNER prior to acceptance.
- B. The CONTRACTOR guarantees that this installation complies with the drawings and specifications in all respects, and is free from defects. He agrees to replace or repair, to the satisfaction of the ENGINEER, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after Final Completion.
- C. The CONTRACTOR guarantees that the installation of OWNER furnished equipment is free from defects. He agrees to provide labor to repair or replace to the satisfaction of the ENGINEER any part of his installation of the OWNER furnished equipment (the respective equipment vendor will provide all parts and labor for the equipment), which may fail or be determined to be unacceptable within a period of one (1) year after Final Completion.
- D. Electrical and instrumentation systems and equipment shall not be considered acceptable for Substantial Completion until they have performed in service continuously without malfunction for at least ten (10) days.

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SECTION 26 05 05
OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. Division-26 Electrical General Requirements sections apply to work of this section.

1.2 SUMMARY

- A. Furnish four sets of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.
- B. Refer to Section 01 34 00 for additional requirements.

1.3 OPERATION AND MAINTENANCE MANUAL FOR ELECTRICAL AND INSTRUMENTATION SYSTEMS

- A. General:
 - 1. The "Operating and Maintenance Manual" (Electrical and Instrumentation) is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.
 - 2. The electrical CONTRACTOR has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the CONTRACTOR for installation.
 - 3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.02A.
 - 4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART 2 - PRODUCTS

2.1 PAGE SIZE:

- A. All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 11 x 17 inches) folded to 8-1/2 x 11 inch.

2.2 DRAWINGS:

- A. All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.3 BINDERS:

- A. Binders shall be Buckram (stiffened fabric), bar-lock type binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".
- B. Place the following information on the front cover and backbone:
 - 1. "Operation and Maintenance Manual".
 - 2. Project Name and Number (and volume number if more than one volume).
 - 3. Equipment name and number.
 - 4. ENGINEER's name.
 - 5. General CONTRACTOR's name.
 - 6. Electrical CONTRACTOR's name.(Items 4 through 6 need not be printed on the backbone.)

2.4 CONTENTS AND INDEXING

- A. Manuals shall contain descriptions of the electrical, control, and instrumentation systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
- B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.
- C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. Copy of purchase order change (if any).
2. Outline drawings, special construction details, "as-built" electrical wiring and control diagrams with wire and terminal number for panel and field wiring for all major and supplementary systems.
3. Manufacturer's test or calculated performance data and certified test curves.
4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
5. Manufacturer's brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
6. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

Part I	Building and System Descriptions
Part II	Purchased Equipment Data
Part III	Test Reports and Charts
Part IV	Start-Up and Operation
Part V	Preventative Maintenance Recommendations
Part VI	Software/Programming Data/Program CD's
8. A copy of the approved submittals for each piece of equipment.
9. A copy of all testing reports.
10. Wiring diagrams, marked with model and size and plan symbol.
11. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.
12. Copies of developed software, programmed setpoints, screens, etc. on C.D.

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SECTION 26 05 07
ELECTRICAL POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Contractor shall provide electrical power system studies for the project. The General Contractor shall hire the engineer of record, engage the manufacturer, or a third-party PE to perform the studies. The type and content of each study is specified in the following articles.

1.2 SUBMITTALS

- A. Completed electrical power system studies shall be bound and submitted to the ENGINEER.
 - 1. Five (5) printed copies (hardcopies) of the completed study report shall be provided and one (1) copy in Microsoft Word or Adobe Acrobat format.
 - 2. The software database and library used to model the power system shall be submitted in native file format including all updates to the library necessary to complete the model.
- B. The CONTRACTOR shall attach brochures, resumes, references and other information indicating how your firm is qualified to provide the services outlined in this document.
- C. The CONTRACTOR is responsible for compliance with all performance specifications in this proposal. Any deviation from complete compliance must be noted on the performance specification submitted for review and approved before work begins.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The analysis software shall be SKM Analysis Software or equal meeting all performance specifications.

2.2 ELECTRICAL POWER SYSTEM STUDIES

- A. An electrical arc flash hazard analysis, including:

1. The development of an up-to-date electrical system one-line diagram and model to provide staff members with an accurate representation of the installed electrical system.
 2. Determination of system operating modes and conditions that can impact short circuit currents and arc flash hazard energy levels.
 3. Short circuit and equipment duty study to verify that equipment is rated to safely handle short circuit currents without creating hazardous conditions.
 4. Protective device coordination study and review to help ensure proper electrical system reliability and to determine if arc flash hazard energy levels can be reduced.
 5. Arc flash hazard analysis study to determine arc flash energy levels and Personal Protective Equipment (PPE).
 6. Power System Modeling and Arc Flash Analysis software for ongoing use by the staff members maintaining and updating the system study as the plant changes.
 7. Arc flash and safety program implementation software for ongoing use by the staff members for arc flash and safety program management and tracking.
 8. Arc flash hazard labeling.
 9. Assistance with the development of Energized Work Permits.
 10. Arc flash and electrical safety training.
 11. Personal Protective Equipment (PPE) training.
- B. An electrical arc flash hazard analysis shall be performed to determine incident energy, arc flash protection boundaries, and required PPE for all electrical equipment in the facility. The calculations shall comply with NFPA-70E 2004, and IEEE-1584-2002. An integral part of NFPA-70E compliance is integrating work permits with arc flash assessment for all equipment in this facility. This section describes in detail the requirements for the study as well as integrating work permits in the system model for 70E compliance.

- C. The purpose of this study is to provide a comprehensive software model of the electrical distribution system, which will document facility compliance with NFPA 70E mandates as described below. This model will serve as an integral part of an ongoing safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E 2004 Article 130.1(A)(2) for each electrical equipment in the facility.
1. Article 205.3, 120.2(F)(1): Updated and verified one-line diagram for all electrical distribution voltages including all sources for lock-out and tag out procedures.
 2. Article 400.5, 400.6: Updated short circuit and equipment duty verification study showing all electrical equipment is properly rated to withstand and interrupt the available short circuit duty per ANSI Standards and NEMA/UL/NEC requirements.
 3. Article 400.6, 410.9: Updated protective device coordination study showing the system protective devices are properly set to coordinate and clear a fault without extensive equipment damage or personnel risk.
 4. Article 130.3(A)(B), 110.8: Updated arc flash study providing maximum incident energies, arc flash boundaries, and PPE requirements for each equipment in the system. In addition, these calculations shall be integrated with 70E compliant work permits as part of an ongoing safety program.
 5. Article 130.16(E), 400.11, 400.14, 400.21(C)(2), 410.8: Updated labeling displaying the worst-case arc hazard values for each equipment in the facility.
- D. The analysis shall consist of the following:
1. Field data collection by qualified personnel (as defined by NFPA 70E).
 2. Data entry and system one-line modeling in commercially available power system software.
 3. Model verification.
 4. Short Circuit and equipment verification study.
 5. Protective device coordination study.
 6. Arc flash hazard study.

7. Detailed report and findings of the analysis.
 8. Electronic copies of the Project Report and the System Modeling File.
- E. The analysis and procedures shall comply with the following standards and recommended practices for power system studies.
1. NFPA-70E, 2004 Standard for Electrical Safety in the Workplace
 2. IEEE-1584-2002
 3. IEEE-242 "Buff Book" Protection and Coordination of Industrial Power Systems
 4. IEEE-399 "Brown Book" Power System Analysis
 5. IEEE-141 "Red Book" Electric Power Distribution for Industrial Plants

2.3 DATA COLLECTION

- A. Field data collection shall be performed by qualified individuals (as defined by NFPA 70E – 2004) to ensure accurate equipment modeling.
- B. Field data collection and system modeling shall be based on the system installed.
- C. Equipment shall be visually inspected to collect the necessary nameplate data used in the analysis, including transformers, switchgear and breakers, relays, direct-acting trip units, etc. Data that may not be readily accessible or may not have nameplate data such as conductors, busway, etc. can be taken from drawings.
- D. Data collection shall include the step down transformer from the utility service (including primary relaying) down through each 480-volt motor control center (MCC) and 240/208 volt panels for all systems served by transformers rated greater than 125 kVA as per IEEE-1584-2002.
- E. The CONTRACTOR shall obtain from the utility the minimum, normal, and maximum operating service voltage levels, three-phase short circuit MVA and X/R ratio, as well as line-to-ground short circuit MVA and X/R ratio at the point of connection as shown on the drawings.

2.4 SYSTEM MODELING

- A. The system model shall be developed using a commercially available, fully integrated software package that meets the performance specifications developed in this Section. To ensure compliance with NFPA-70E 2004, ANSI, and IEEE Standards, and OSHA mandates, no exceptions or substitutions to the performance specification are allowed.
- B. The system model shall be laid out in one drawing/view and in a manner that provides for easy viewing of all analysis results. The one drawing/view requirement ensures that problem areas found and highlighted by the program are easily seen and not hidden or buried in multiple drawings, eliminating potential human errors where multiple drawing verification is required.
- C. All one-line symbols shall be spaced properly to facilitate viewing results on the one-line.
- D. Equipment names used in the modeling software shall be identical to the equipment and naming convention shown on the drawings and equipment unless conflicts exist. The CONTRACTOR shall bring all naming convention conflicts or deficiencies to the attention of the ENGINEER for clarification.
- E. The facility may have multiple operating conditions, including, but not limited to, generation on/off, shutdown, bus-ties, start-up, emergency operation, etc. Each of the operating modes shall be documented and modeled in the software in order to determine the worst-case arc flash hazard and associated parameters for the electrical equipment. For the purpose, assume that up to four (4) operating modes are possible.
- F. The software shall model each operating mode in a manner such that each mode is a scenario or change case from the base case. Each scenario shall be a simple differential algorithm storing only the difference from the base case and the scenario. Modifications to the base case model shall automatically update all scenarios to eliminate the necessity to store complete databases for each condition, providing for a manageable file size that can be Emailed and eliminating the associated time, man hours, and errors with updating each database individually.

- G. Project files created by the software shall be single files and not project directories containing multiple files. The file shall be self-contained and have all necessary information to describe the one-line, system data, settings, and analysis information. Files shall be easily transferable to any site via Email or disk and operable with no setting changes to the database file to eliminate the maintenance and administrative problems associated with multi-file project directories, and to provide an easy method to transfer the file for engineering review.
- H. The software shall accurately model daisy-chained MCC's, panels, and sub-transformers without the use of intermediate buses, nodes or fake impedances.
- I. Lumped motor groups for MCC's shall be modeled per IEEE standards using groups >50 Hp, and <50 Hp. Where motor list data is not available, single lumped groups may be modeled per IEEE-141 "Red Book".
- J. Medium voltage motors greater than 1.0 kV shall be modeled individually on their respective buses including all protective phase and ground overcurrent relays and fuses. This model will provide individual work permits for each starter/motor on the one-line.
- K. All low voltage power circuit breaker (LVPCB), insulated case (ICCB), molded case (MCCB) and fuse data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
- L. All relay data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
- M. All overcurrent relay types for the distribution system shall be modeled on the one-line diagram (and database) including phase and ground overcurrent, differential, residual, ground neutral, etc. to establish a complete and detailed system model where protective device data can be easily modified and updated by the facility and all data is available for a comprehensive protective device coordination study if required in the future.
- N. Relay models shall depict the actual connection requirements. See Figure-1.3M. Programs using symbols as shown in Figure-1.3M(na) are not acceptable since they do not depict the actual system and can lead to confusion in determining arc flash results and proper protective device modeling.

- O. Multi-function relays shall have all their overcurrent devices modeled in a single device and shall be able to accept multiple CT's.
- P. All equipment modeling must have a corresponding one-line diagram symbol. This means that there can be no hidden database models. The purpose is for the facility to easily see all equipment, its associated data, to be able to link documents to the equipment as a data repository, etc. and to see problems right on the one-line.
- Q. All system modeling shall conform to accepted modeling practices as outlined in IEEE-399 "Brown Book". Contractor/consultant may provide more advanced modeling techniques where compliance with the specification is maintained.

2.5 MODEL VERIFICATION

- A. The system model shall be verified by reviewing the results of short circuit current flows for all buses/equipment in the system. The results shall be viewed on each branch and total flow into a bus/equipment on the system one-line diagram. The purpose is to visually spot check values with recognized industry benchmarks as to the expected amount of short circuit current, and correct any problem areas.

2.6 SHORT CIRCUIT STUDY

- A. A short circuit study shall be performed to verify all equipment duties in the system. The calculations shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The short circuit study shall verify the system electrical equipment is properly rated to withstand and interrupt the expected bolted and arcing faults in the system. Improperly rated and applied equipment may not protect personnel against arc flash hazards even if properly applied PPE is used. The software program must comply with the above standards in order to properly verify equipment installed in North America. No substitutions will be allowed.
- B. The equipment duty verification shall determine both the line side and load side fault current through each equipment and use the highest current to verify equipment ratings. Standard bus faults are not acceptable for protective devices in that they do not accurately model the current through the device and consequently they provide erroneous results. For solidly grounded systems, both three-phase and single-line-to-ground faults should be modeled. For other grounding configurations only a three-phase fault is required.
- C. Equipment duty results shall be graphically displayed on the electrical one-line as well as tabular report format.

- D. The results of the equipment duty verification tabular format report shall provide the following data:
 - 1. Equipment name and kV
 - 2. Manufacture, type, style, and ratings of the device
 - 3. Actual line or load side currents through the device and percent over/under duty
 - 4. Flag for the device showing VIOLATION or WARNING level for visual identification

- E. A report of all problem areas shall be provided. Contractor shall notify the project management corporation – and owner facility personnel immediately of all problems found in this system before proceeding in the study. A recommended action list shall be provided for all underrated equipment in the system.

2.7 PROTECTIVE DEVICE COORDINATION (PDC) STUDY

- A. A PDC study shall be performed in order to determine if the system protection characteristics are sufficient to provide reliable power to the facility. The PDC study will also determine if the settings entered in the software will provide proper personnel protection in the arc flash portion of this study. For facilities where the main distribution is low voltage (under 600 volts) and only instantaneous breakers or fuses are used, this section may not apply.

- B. The PDC study shall consist of system feeders and branch circuits 100amps and larger, and plotting the time-current curves (TCC's) to verify proper selective operation of the protective devices. The study should also determine if the settings can be enhanced to provide increased personnel/equipment protection without sacrificing selective coordination.

- C. The CONTRACTOR shall notify the ENGINEER of any potential problems in the protective device settings that affect either selective operation and reliability or personnel protection and shall provide recommendations for changes in writing before continuing with the study.

- D. As specified in the data collection and modeling sections, all PDC data shall be modeled on the one-line diagram and in the equipment database.

- E. The CONTRACTOR shall contact the serving utility and obtain protective device settings for all service entrance over current devices in series with the facility and affecting coordination with facilities distribution system.
- F. TCC Specifics: The TCC's shall graphically illustrate on log-log paper that adequate time separation exists between series devices. The specific time - current characteristics of each protective device shall be plotted in such a manner that sufficient upstream devices will be clearly depicted on one sheet to prove selective coordination.
 - 1. TCC's shall include a system one-line diagram and protective device coordination curves for each device in the selected area. The TCC shall be printed in color on 8 ½ x 11" paper – full size portrait mode, using a log-log scale. The one-line diagram shall be part of the TCC and include all protective devices, equipment names, and short circuit currents calculated from the main one-line. The purpose of this requirement is to provide all necessary information on one sheet, in a format easily readable and standard to the industry.
 - 2. For low voltage systems, TCC's shall be developed for both phase and ground protective devices. One phase and one ground TCC should be developed for each unit substation. The TCC should show the largest feeder/motor protective device in the MCC or panel up through the switchgear/switchboard feeder breaker, transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker. For secondary switchboards serving large loads or a wide variety of loads that may affect upstream coordination, additional TCC's may be required.
 - 3. For medium voltage systems, TCC's shall be developed for both phase and ground protective devices. The TCC should show the largest feeder/motor protective device in the lineup up through the switchgear/transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker.
 - 4. The following specific information shall also be shown on the coordination curves:
 - a) Device identification.
 - b) Voltage and current ratio for curves.
 - c) Transformer three - phase and single-line-to-ground ANSI damage curves.

- d) Transformer inrush points.
- e) Minimum melting, and clearing curves for fuses, and if available the no-damage curve.
- f) Cable damage curves.
- g) Motor starting locked rotor curves, and if available the motor locked rotor damage point.
- h) Maximum short circuit cut-off point.
- i) Clearly marked short circuit current levels through each protective device/branch, which should be based on the appropriate current through the device, i.e. Momentary, Interrupting or 30 Cycle current.
- j) Protective device one-line diagram clearly showing all protective devices on the time-current curve, labels for each device, open breakers, faulted buses, and the short circuit current flowing in each branch.
- k) Each TCC sheet shall have appropriate identification and a one-line diagram that applies to the specific portion of the system associated with time-current curves on that sheet.
- l) Each protective device curve shall be terminated at a point reflecting maximum symmetrical or asymmetrical fault current through the device.
- m) Identify the device associated with each curve by manufacturer type, function, and setting – i.e. tap, time delay, and instantaneous, pickup, etc.
- n) Primary Protective Device Settings for Delta-Wye Connected Transformer:
 - 1) Secondary Line-To-Ground Fault Protection: Provide primary protective device operating band within the transformer's characteristics curve, including a point equal to 58 percent of ANSI C57.12.00 withstand point.

- 2) Secondary Line-To-Line Faults: Provide 16 percent current margin between primary protective device and associated secondary device characteristic curves.
 - o) Typical time separations for curves:
 - 1) Consultant/contractor shall discuss the advantages and disadvantages of various time separation settings between device curves with the project management company and owner facility personnel to help determine how the system settings shall be optimized for selectivity and arc flash hazard reduction.
- G. A setting table shall be developed to summarize the settings selected/existing for the protective devices. The table shall include the following:
 1. Device identification.
 2. For low voltage breakers, the circuit breaker manufacturer, type, and style, sensor rating, long-time, short-time, instantaneous settings, and time bands. For breakers with ground fault capability, the pickup and time delay.
 3. Fuse manufacturer, type, style, and rating.
 4. Protective relay manufacturer, type, style, function (51, 50, 67, etc.) pickup, current multiplier, time dial, and delay. For multi-function units, list all devices being used. Include the CT and/or PT ratios for each function.
- H. The software shall provide complete integration of the one-line, database, short circuit, protective device coordination and arc flash analysis functions to provide accurate calculations and avoid errors and inefficiencies associated with multiple data entry programs. Programs using separate PDC or TCC plotting packages are not allowed. Complete PDC integration is defined as the following:
 1. TCC's shall be developed by simply selecting (highlighting) with the mouse the one-line area to be coordinated. The TCC shall automatically be plotted for the selected area including all short circuit levels. The TCC plot shall automatically include the selected one-line area in a drag and drop window on the TCC showing all one-line attributes without user additions required. These attributes shall automatically include all short circuit currents and voltages displayed on the main one-line, equipment names, etc. and update automatically without additional user input.

2. Programs requiring the user to build a separate TCC one-line are not integral with system short circuit calculations and do not automatically update as the system one-line changes, requiring additional man-hours for one-line development and are consequently prone to errors as the system changes. These types of programs shall not be considered for the study.
3. Each TCC shall have momentary (1/2 cycle), interrupting (1-4 cycle), and 30 cycle short circuit currents (tick marks) displayed on the TCC plot for each protective device or as required to properly model the tripping characteristics of the device. The tick marks shall be user adjustable for visual appearance. The purpose is to provide accurate tripping currents for each device.
4. The software model shall allow each protective device to model momentary (1/2 cycle), interrupting (1-4 cycle), and 30 cycle short circuit currents simultaneously depending on the characteristics of the device.
5. The software shall model remote voltages and currents for any single fault and display them on the TCC showing all trip cutoffs based on the remote currents. The purpose is to accurately model and verify backup relaying to ensure selective operation under all fault conditions. PDC programs that perform only batch faults, or fail to model remote voltages and currents for all fault types shall not be considered.
6. The software shall model and display time difference calculations for any selected pair of protective devices. The difference calculator shall include bracketing bars with the calculated difference to clearly show the selective time between the devices. The calculated time shall update dynamically for instant visual setting as the devices are dragged (settings modified). In addition, tool tips shall clearly show the time difference and the protective device settings for all devices as they are dynamically changed or set to allow the user to accurately determine the proper setting between devices in the most efficient manner, reducing coordination time and providing more accurate results.
7. The software model shall provide for WYSIWYG drag and drop modeling of all protective devices and provide for tool tips and notes to display all settings dynamically. The purpose is to provide accurate adjustments and settings in the most time efficient and accurate manner.

8. TCC's shall have the ability to display short circuit currents and arc flash hazard results within the fully integrated system one-line in the PDC focus. Short circuit currents are available at any equipment with a single mouse click. Short circuit currents and arc flash hazard values shall change on the fly as the protective device settings change, allowing the user to instantly see the results of PDC changes and the associated impact to short circuit currents and arc flash hazard values.
9. The software model shall provide a detailed library for the most common protective devices available in North America. The library shall be user definable.

2.8 ARC FLASH STUDY

- A. A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical system studied. The calculations shall comply with NFPA-70E 2004, and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA-70E and to facilitate a safety program for the OWNER, and to provide a comprehensive software model of the electrical distribution system, which provides integral work permits and arc flash calculations in compliance with NFPA 70E Article 130.1(A)(2) for all equipment in the facility. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.
- B. The arc flash study shall determine the following results for each system mode of operation. The results shall be provided in spreadsheet format for each mode and electrical system location to provide easy viewing and comparison. Worst-case arc flash energy levels shall be flagged and the spreadsheet comparison table shall be capable of providing its output directly to high quality vinyl label printers. The calculations shall, as a minimum, include a comparison of both 100% and 85% arcing currents for low voltage equipment for each electrical system configuration or operating mode, indicating worst-case arc flash hazards. The spreadsheet results shall include:
 1. Equipment name and voltage.
 2. Upstream equipment device name and ANSI function, i.e. 51/50, etc.
 3. Equipment type, i.e. switchgear, MCC, Panel, VFD, etc.

4. Equipment arc gap.
 5. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
 6. Trip time, opening time, and total clearing time (total Arc time) of the protective device.
 7. Worst-case arc flash boundary for each bus/equipment in the model.
 8. Worst-case arc flash hazard incident energy in cal/cm² for each bus/equipment in the model.
 9. Worst-case personal protective equipment (PPE) for each bus/equipment in the model.
 10. Working distances for up to five different distances showing items 7, 8, and 9 for each distance.
 11. Indicate “Danger/Hazardous” areas where incident energy is greater than 40 cal/cm² and provide recommendations to reduced arc flash energy levels for these areas.
 12. Flag results where 85% arcing current provided worst-case results.
- C. Each mode of operation shall include a detailed write-up indicating areas where incident energy calculations and PPE requirements are higher than calculated in the normal operating mode.
- D. Consultant/contractor shall provide a detailed arc flash analysis report including as a minimum:
1. Introduction.
 2. Methodology.
 3. Information Sources.
 4. Key Assumptions.
 5. Arc Flash Energy and other consideration for various System Modes of Operation (maintenance mode, bus-tie, co-gen on/off, etc.).
 6. Arc Energy at 100% and reduced currents.

7. IEEE 1584-2002 Considerations.
8. Overcurrent Protective Device Changes, Replacements or Setting Changes implemented in study to reduce arc flash hazard exposure.
9. Explanation of Data in Arc Flash Hazard Report Tables.
10. NFPA 70E Information.
 - a) Shock Hazards with covers removed.
 - b) Shock Hazard Approach Boundaries.
 - 1) Limited Approach Boundary.
 - 2) Restricted Approach Boundary.
 - 3) Prohibited Approach Boundary.
 - c) Arc Flash Hazard Boundaries.
11. Results of Arc flash Hazard Analysis for high voltage, medium voltage and low voltage systems, including:
 - a) Working distances.
 - b) Energy Levels.
 - c) PPE Requirements.
 - d) Recommendations to reduce arc flash hazard energy and exposure.
12. Arc Flash Hazard Report.
 - a) 5 Hard Copies.
 - b) 1 Electronic Copy in Adobe Acrobat format (5.0 or later).
13. Electronic file for Power System Modeling Software as developed and utilized for this analysis.

- E. The CONTRACTOR shall provide printed labels for labels for all equipment in the system from the project study file. Assume three (3) labels per equipment/bus in your estimate using 4" x 6" labels or one (1) 6" x 8" label per equipment bus. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z535. The labels shall be printable directly from the power system software utilized for the study with a Duralabel, Brady PowerMark or GlobalMark printer to ensure that the OWNER's personnel have the option of printing the labels without the extra expense of going to an outside printing service, converting arc flash results to spreadsheet format or performing tedious manual data entry.
- F. Software Requirements: The software shall provide complete integration of the one-line, database, short circuit, PDC and Arc flash functions. Software using separate short circuit, PDC, TCC or arc flash programs is not allowed. Spreadsheet calculations are not allowed. The purpose of this section is to ensure that the arc flash hazard calculations comply with NFPA-70E and IEEE-1584, and that the calculations are programmed with necessary requirements to help eliminate possible errors in the arc flash calculations. The additional purpose is to establish a detailed software model of the project management company and owner facility electrical distribution system, which will document compliance with the OSHA requirements and NFPA 70E mandates. This model will serve as an integral part of the OWNER's safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E Article 130.1(A)(2) for each electrical equipment in the facility.
1. Arc flash calculations shall be performed with enhanced IEEE-1584 equations, which eliminate voltage discontinuities and the non-conservative/average results of the standard equations. The purpose of this requirement is to ensure that the calculated incident energies are closer to actual test results insuring a conservative calculation minimizing personnel risk.

2. Arc flash calculations shall be based on the fastest clearing upstream protective device protecting the equipment for single sources and the slowest upstream protective device for multiple sources. The calculations shall automatically compare all series and parallel upstream protective devices in the system to determine the fastest series device or a conservative parallel clearing time. The algorithm shall incorporate a traversing routine that can search back an unlimited number of buses/nodes and consider all series and parallel branches in the comparison to ensure accurate answers and to prevent hazards associated with incorrect results. Software shall not have trace back limits (5-10 buses) that can provide incorrect answers for low voltage faults that require high voltage protective device clearing to prevent potential errors.
3. The arc flash calculations including arc flash boundary, incident energy, PPE requirements, and working distance shall be displayed on the software one-line diagram and TCC simultaneously. The software must show visually the arc flash values as the settings are incrementally changed (dragging curves) so the protection can be optimized in the most efficient manner, allowing the protection engineer to visually balance the competing objectives of personnel protection with that of system selectivity.
4. The arc flash calculations shall include four (4) calculation options to ensure that the software provides the flexibility required to meet any system configuration or training requirement that may be considered. Each calculation option shall comply with the graphic and spreadsheet display requirements of this section. Each option is more specifically described below.
 - a) The detailed option shall provide the let-through energy for each protective device in the system. This is the energy on the load side of the protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.

- b) Worst-case including main protective device. This option shall provide the worst-case arc-hazard energy for the equipment based on the let-through energy of the equipment's main protective device. If the equipment is not equipped with a main device, the program must traverse back the entire system to determine the fastest series upstream protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
 - c) Worst-case excluding main protective device. This option shall provide the worst-case arc-hazard energy for the equipment based on the let-through energy of the fastest upstream series protective device in the system. The program shall traverse back the entire system to determine the fastest upstream protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
 - d) Worst-case excluding and including the main protective device. A combination of options 'b' and 'c' as stated above.
5. The arc flash calculations shall provide integral "Work Tasks" for the listed equipment types. The tasks shall be derived from 70E Table 130.7(C)(9)(a) and be specific to the equipment type. Work tasks shall be user definable in the software to allow customization and integral with the "Work Permit" feature of the software. Listed equipment types shall include:
- a) Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 100-200 volt equipment.
 - b) Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 200-1000 volt equipment.
 - c) Switchgear, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 1.0-5.0 kV equipment.
 - d) Switchgear, MCC, VFD, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 5.0-15.0 kV equipment.
 - e) Switchgear, Interrupting Switch, Conductor, Open Air for 15.0-38.0 kV equipment.

- f) Interrupting Switch, Conductor, and Open Air for 38.0-1500 kV equipment.
6. Work Tasks shall have a user-defined library that provides the following customizable features for each work task:
- a) Work Tasks for each specific equipment type and voltage range.
 - b) Working distance units English or Metric.
 - c) Work distance for each task.
 - d) V-rated gloves and tool requirements.
 - e) Job description and procedures.
 - f) Safe work practices description.
 - g) Hazard Risk Category (HRC) reduction. *Note: HRC reduction can only be used based on a documented risk assessment as an integral part of a safety program.
7. Work tasks shall be accessible from the one-line diagram for any equipment through a mouse click on the equipment in the electrical system model one-line. A dialog box shall appear listing all 70E and user definable work tasks for the specific equipment selected. The work task dialog shall include a user definable working distance for each work task and allow the user to select tasks specific to any equipment feeder or the incoming main. Work tasks for each equipment type shall be voltage specific and user definable in the library. The purpose of these requirements is to integrate 70E work tasks to the one-line diagram for specific equipment types. This will provide the basis for a customized safety program and work permit process compliant with 70E mandates. The level of detailed requirements for the “work task” software is necessary to ensure that any variation of equipment type, equipment layout, or work procedure can be handled and documented in the software.
- a) The software interface shall allow the user to select any breaker fuse or switch on the one-line, and get a specific work task generated for that device showing the load side arc flash hazard (let-through energy) for that device. The purpose of this requirement is to detail specific feeder hazards when work tasks dictate working downstream from a feeder protective device.

- b) The arc flash calculations shall provide integral work permits for compliance with NFPA-70E, 2004 Article 130.1 (A). The work permits shall be integral with the system one-line diagram and the arc flash calculations and shall detect and account for work between feeder and main breaker.
8. Work permits shall be activated by mouse click, for all equipment types listed in K5. Work permits shall have the following calculated values and provide the following information specific to the “work task” and equipment selected:
- a) Shock hazard.
 - b) Shock hazard boundaries.
 - c) Arc flash boundary – worst-case for each equipment.
 - d) Arc flash hazard incident energy in cal/cm² for the equipment.
 - e) Hazard Risk Category (HRC) and any applicable risk reduction.
 - f) Required PPE category based on calculated energy level and optional risk reduction.
 - g) Required PPE description based on PPE category.
 - h) Determination of V-rated gloves and tools.
 - i) Auto fill job description and procedures for each work task.
 - j) Auto fill safe work practices description for each work task.
 - k) Job briefing and planning check list.
 - l) Approval sign off section.
 - m) Working distance measurements in English or Metric units.
 - n) Required work distance for each task.
 - o) Documentation for safety program in compliance with 70E 130.1(A).
9. The work permits shall be created by the software in MS Word and have the following user customizable features:

- a) Work Tasks for each specific equipment type and voltage range.
 - b) Restricted shock boundary.
 - c) Arc flash boundary – worst-case for each equipment.
 - d) Arc flash hazard incident energy in cal/cm² for the equipment.
 - e) Hazard Risk Category (HRC) reduction for low risk tasks.
 - f) Required PPE category based on risk reduction.
 - g) Working distance in English or Metric units.
 - h) Working distance for each task.
 - i) V-rated gloves and tool requirements.
 - j) Flame Resistant clothing requirements.
 - k) Job description and procedures for each work task.
 - l) Safe work practices description for each work task.
 - m) Job briefing and planning check list.
 - n) Approval sign off section.
10. The power system software shall allow the created work permits to be linked via Windows “hyperlinks” to each equipment on the one-line diagram. The purpose is to provide a data repository of work permits performed on each equipment for 70E review, as well as providing a one-stop location where documents pertaining to the equipment can be accessed by maintenance and job planning.
11. The power system software shall be fully compatible with facility arc flash hazard and electrical safety implementation software that provides the following capabilities:
- a) Calculates shock hazards, shock hazard boundaries, arc flash boundaries, incident energies, PPE requirements, etc. for power systems modeled in EasyPower or EasyPower EasySolv.

- b) Built in Work Permit Feature for creation of custom Energized Work Permits complying with the NFPA-70E requirements. Work permit feature shall include NFPA risk assessment categories based on the task performed for all types of electrical equipment and voltage ranges. The work permit feature shall include an extensive library of user definable work tasks, safety procedures and safe work practices.
- c) Energized work permits, safety procedures, equipment instruction manuals, etc., shall be capable of being directly linked to the equipment one-line through a Hyperlinks feature, providing a one-stop data repository easily accessible to all plant and safety personnel, saving plant personnel and contractors significant productive time in locating the right instruction manual, equipment safety procedure, drawing, pictures and maps for the equipment. This feature shall also help interested parties with OSHA and NFPA 70E record keeping requirements.
- d) Additional equipment information and records such as Maintenance Records, Maintenance Manuals, Operations Manuals, Lock out / Tag out procedures, etc. shall also be capable of being Hyperlinked to the equipment on the graphical one-line.
- e) Program shall support creation of arc flash labels with direct output to high quality UV resistant vinyl label printers.
- f) Program shall also have customizable output. Includes one-line printing, text report creation, export to AutoCAD, etc.
- g) Program shall be a Windows based operating system and shall use Windows conventions.
- h) Program shall be capable of being installed on stand alone personal computers or on networked systems.
- i) Program shall be easily operable by the OWNER's staff without any specialized training.

- 12. The software shall be licensed to the OWNER and the original software package will be delivered at project completion.

2.9 REPORTING AND ANALYSIS SUMMARY

- A. Executive Summary: The executive summary shall be brief 1-2 pages maximum and cover at an executive level the findings of the study, recommendations, and requirements for maintaining NFPA-70E compliance.
- B. Scope of studies performed: The scope shall provide details of what actions were intended to be performed for each aspect of the study, including short circuit, protective device coordination, and arc flash.
- C. Description of system and explanation of bus and branch numbering system.
- D. Modes of operation studied: Each scenario/plant operating condition shall be thoroughly documented.
- E. Detailed report and results of short circuit, coordination, and arc flash studies including:
 - 1. Recommendations and additions to equipment rating and/or PDC characteristics.
 - 2. Recommendations to reduce arc flash hazards for equipment with incident energies over 40 cal/cm².
- F. Prioritized recommendations for all studies.
- G. Action list and check off column for all recommendations.

2.10 QUALITY ASSURANCE

- A. The studies shall be in conformance with the NFPA and ANSI Standards, and IEEE recommended practices detailed in this section. No substitutions in study methods or software conformance will be allowed.

END OF SECTION

SECTION 26 05 08
ELECTRICAL ACCEPTANCE TEST

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. This section covers the work necessary to provide the inspection and testing services required to place the electrical system into operation.

1.2 GENERAL

- A. See General Conditions and Division 01 (Sections 010100 through 017000), GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.
- B. This work may be conducted by the electrical subcontractors and/or independent testing laboratory but shall be performed by qualified personnel. The decision concerning acceptability of the qualifications of the individual and/or firm conducting the tests shall be determined during submittal review in accordance with Section 01 40 00, Quality Control. The term "testing laboratory" shall unilaterally refer to the firm, subcontractor, etc., approved to conduct the tests.
 - 1. For the purposes of the section the individual performing the testing, whether the electrical subcontractor, manufacturer's representatives or independent testing laboratory, shall be referred to as "testing laboratory."
 - 2. The Contractor shall submit a division of responsibilities that shall detail who is responsible for performing each test.
 - 3. All visual and mechanical inspections shall be conducted by the Contractor and Engineer.
- C. The testing laboratory shall provide all material, equipment power, labor and technical supervision to perform such tests and inspections.
- D. It is the intent of these tests to assure that all electrical equipment is operational within industry and manufacturer's tolerances.
- E. Upon completion of the tests and inspections noted in these specifications, a label shall be attached to all serviced devices. These labels will indicate date serviced and the service company responsible.
- F. The tests and inspections shall determine suitability for continued reliable operation.
- G. All tests shall be conducted in the presence of the Engineer.
- H. Electrical testing specified herein, and functional testing of all power and controls not tested under the Section 40 10 00, Process Control and Instrumentation Systems, shall be completed before commencement of the 7-day test specified in Section 26 05 08, Electrical Acceptance Tests.

- I. The work may require the Contractor to activate circuits, shutdown circuits and run equipment, make electrical measurements, replace blown fuses, install temporary jumpers, etc.
- J. Specific scope of work:
 - 1. The following items of equipment shall be tested:
 - a. Low voltage switchgear
 - b. Motor control centers
 - c. Transformers
 - d. All wires and cables
 - e. Motors
 - f. Grounding system
 - g. Entire control system and all process interfaces
 - h. Adjustable speed drive (ASD) systems
 - i. Switches
 - j. Lighting
 - 2. All inspections and tests shall utilize the following references:
 - a. Project design specifications
 - b. Project design drawings
 - c. Manufacturer's instruction manuals applicable to each particular apparatus.
- K. Division of responsibility:
 - 1. The Contractor shall perform routing insulation resistance, continuity and rotation tests for all distribution and utilization equipment prior and in addition to tests performed by the testing laboratory specified herein.
 - 2. The Contractor shall supply a suitable and stable source of test power to the test laboratory at each test site. The testing laboratory shall specify requirements.
 - 3. The Contractor shall notify the testing laboratory and schedule with the Engineer when equipment becomes available for acceptance tests.
 - 4. The Contractor shall notify the Engineer prior to commencement of any testing.
 - 5. The testing laboratory shall be responsible for implementing all final settings and adjustments on protective devices and tap changes in accordance with Owner's specified values.

6. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported directly to the Engineer.
7. The testing laboratory shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.

1.3 REFERENCED STANDARDS

- A. See Section 26 05 00, General Electrical Requirements, which lists the standards that apply to the work specified herein.
- B. In addition, the following shall apply:
 1. Manufacturer's recommended tests
 2. ANSI C2, C37.20.1
 3. NEMA WC 7, WC 8
 4. IEEE 43,48,81,118
 5. NETA ATS
 6. NFPA 70

1.4 SUBMITTALS DURING CONSTRUCTION

- A. Submittals during construction shall be made in accordance with Division 1, GENERAL REQUIREMENTS and Section 26 05 00, General Electrical Requirements.
- B. In addition, the following information shall be provided:
 1. Shop drawings:
 - a. The testing laboratory shall submit, in conformance with Section 01 30 00, Contractor Submittals, a complete resume and statement of qualifications detailing their experiences in performing the test specified. This statement shall include:
 - 1) Corporate history and references.
 - 2) Resume of individual performing test.
 - 3) Equipment list and test calibration data.
 - b. The Contractor shall submit to the Engineer and the testing laboratory, in conformance with Section 01 30 00, Contractor Submittals, complete manufacturer's field testing acceptance testing procedures, as well as expected test results and tolerances for all equipment to be tested.
 - 1) Administrative Submittals: Submit 30 days prior to performing inspection or tests:

- 2) Schedule for performing inspection and tests.
- 3) List of references to be used for each test.
- 4) Sample copy of equipment and materials inspection form(s).
- 5) Sample copy of individual device test form.
- 6) Sample copy of individual system test form.
- 7) Quality Control Submittals: Submit within 15 days after completion of test:
Test or inspection reports and certificates for each electrical item tested.
- 8) Contract Closeout Submittals:
 - a) Operation and Maintenance Data:
 - b) In accordance with Section 26 05 00, Operation and Maintenance Data
 - c) After test or inspection reports have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.

2. Test Report:

- a. The test report shall include the following:
 - 1) Summary of project.
 - 2) Description of equipment tested.
 - 3) Description of test.
 - 4) Test results.
 - 5) Conclusions and recommendations.
 - 6) Appendix, including appropriate test forms.
 - 7) List of test equipment used and calibration date.
- b. Furnish six (6) copies of the completed report to the Engineer in conformance with Section 01 30 00, Contractor Submittals.

PART 2 - PRODUCTS

2.1 TEST INSTRUMENT TRACEABILITY

- A. The testing laboratory shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.
- B. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain.
- C. Instruments shall be calibrated in accordance with the following frequency schedule.
 1. Field instruments - 6 months maximum.

2. Laboratory instruments - 12 months.
 3. Leased specialty equipment - 12 months. (Where accuracy is guaranteed by lessor).
- D. Dated calibration labels shall be visible on all test equipment.
- E. Records must be kept up-to-date which show date and results of all instruments calibrated or tested.
- F. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.

PART 3 - EXECUTION

- A. Safety and Precautions:
1. Safety practices shall include, but are not limited to the following requirements:
 - a. Occupational Safety and Health Act - OSHA
 - b. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
 - c. Applicable State and Local safety operating procedures.
 - d. NETA Safety/Accident Prevention Program.
 - e. National Fire Protection Association - NFPA 70E.
 2. The testing laboratory shall be solely responsible for safety during all tests.
 3. In all cases, work shall not proceed until the testing laboratory, Contractor, and Engineer determine that it is safe to do so.
 4. The testing laboratory shall have available sufficient protective barriers and warning signs to conduct specified tests safely.
- B. Testing requirements prior to commencing the work:
1. All instruments required must be available and in proper operating conditions.
 2. All dispensable materials such as solvents, rags and brushes required must be provided.
 3. All equipment handling devices such as cranes, vehicles, chain falls and other lifting equipment must be available or scheduled.
 4. All instruction books, calibration curves or other printed material to cover the electrical devices must be available.
 5. Data sheets to record all test results must be available before the work is started.
- C. Tests and inspection shall establish that:

1. Electrical equipment is operational within industry and manufacturer's tolerances.
 2. Installation operates properly.
 3. Equipment is suitable to be energized.
 4. Installation conforms to requirements of these specifications and NFPA 70, NFPA 70E, and ANSI C2.
- D. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- E. Adjust all mechanisms and moving parts for free mechanical movement.
- F. Adjust all adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance with these specifications.
- H. Realign equipment not properly aligned and correct any unevenness.
- I. Properly anchor electrical equipment found to be inadequately anchored.
- J. Tighten all accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or otherwise specified.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of all applicable moving parts.
- M. Inform Engineer of any working clearances not in accordance with NFPA 70.
- N. Investigate and repair or replace:
1. Electrical items that fail tests.
 2. Active components not operating in accordance with manufacturer's instructions.
 3. Damaged electrical equipment.
- O. Electrical enclosures:
1. Remove foreign material and moisture from enclosure interior.
 2. Vacuum and wipe clean enclosure interior.
 3. Remove corrosion found on metal surfaces.
 4. Repair or replace, as determined by the Engineer, door and/or panel sections having dented surfaces.
 5. Repair or replace, as determined by the Engineer, poor-fitting doors and/or

panel sections.

6. Repair or replace improperly operating latching, locking, or interlocking devices.

7. Replace missing or damaged hardware.

8. Finish:

a. Provide matching paint and touch-up scratches and mars.

b. If required due to extensive damage, as determined by the Engineer, refinish the entire assembly.

P. Replace fuses and circuit breakers that do not conform to size and type required by these specifications.

Q. Replace transformer insulating oil not in compliance with ASTM D923.

3.2 **QUALITY ASSURANCE**

A. Testing Firm's Qualifications:

1. Corporately and financially independent organization which can function as an unbiased testing authority.

2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.

3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.

4. Supervising engineer accredited as Certified Electrical Test Technologist by National Institute for Certification of Engineering Technologies (NICET), or International electrical Testing Association and having a minimum of five (5) years testing experience on similar projects.

5. Technicians certified by NICET or NETA.

6. Assistants and apprentices assigned to project at ratio not to exceed two (2) certified to one (1) noncertified assistant or apprentice.

7. Registered Professional Engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.

8. In compliance with OSHA 29 CFR Part 1907, "Criteria for Accreditation of Testing Laboratories," or a full-member company of the International Electrical Testing Association.

9. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.

B. Test instrument calibration shall be in accordance with NETA ATS.

3.3 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment are to be:

1. Scheduled with Engineer prior to de-energization.

2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify Engineer at least 24 hours prior to performing any tests on energized electrical equipment.

3.4 INSPECTION AND TEST PROCEDURES

A. Switchgear Assembly:

1. Visual and mechanical inspection for:

a. Physical damage

b. Equipment nameplate information conformance with latest single line diagram and report discrepancies.

c. Proper alignment, anchorage and grounding.

d. Tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instruction for proper foot pound levels.

e. Paint chips, dents, scratches, etc.

f. Insulator damage and contaminated surfaces.

g. Proper barrier and shutter installation and operation.

h. Proper operation of indicating devices.

i. Improper blockage of air cooling passages.

j. Integrity and contamination of bus insulation system.

k. Check nameplates for proper identification of:

1) Equipment title and tag number with latest one-line diagram.

2) Pushbuttons.

3) Control switches.

4) Pilot lights.

5) Control relays.

- 6) Circuit breakers.
- 7) Indicating meters.
- l. Verify that fuse and/or circuit breaker ratings, sizes, and types conform to those specified.
- m. Check bus and cable connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints.
 - 1) Ohmic value to be zero.
 - 2) Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
- n. Check operation and sequencing of electrical and mechanical interlock systems by:
 - 1) Closure attempt for locked open devices.
 - 2) Opening attempt for locked closed devices.
 - 3) Key exchange to operate devices in off-normal positions.
- o. Verify performance of each control device and feature.
- p. Control wiring:
 - 1) Compare wiring to local and remote control and protective devices with elementary diagrams.
 - 2) Proper conductor lacing and bundling.
 - 3) Proper conductor identification.
 - 4) Proper conductor logs and connections.
- q. Exercise all active components.
- r. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.

2. Electrical tests:

- a. Insulation resistance test:
 - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7. 1. 1.
 - 2) Each phase of each bus section.
 - 3) Phase-to-phase and phase-to-ground for 1 minute.
 - 4) With switches and breakers open.
 - 5) With switches and breakers closed.

- 6) Control wiring except that connected to solid state components.
- 7) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

b. Overpotential test:

- 1) Applied voltage and test procedure in accordance with ANSIC37.20.1.
- 2) Each phase of each bus section.
- 3) Phase-to-phase and phase-to-ground for 1 minute.
- 4) Test results evaluated on a pass-fail basis.

c. Current injection tests:

- 1) For entire current circuit in each section.
- 2) Secondary injection for current flow of 1 ampere.
- 3) Test current at each device.

d. Control wiring:

- 1) Apply secondary voltage to all control power and potential circuits.
- 2) Check voltage levels at each point on terminal boards and each device terminal.

e. Operational test:

- 1) Initiate all control devices.
- 2) Check proper operation of control system in each section.

3. Test values:

- a. Bolt torque levels shall be in accordance with values specified by manufacturer.
- b. Insulation resistance test to be performed in accordance with manufacturer's specified values.

B. Grounding Systems:

1. Visual and mechanical inspection for:

- a. Compliance with plans and specifications.
- b. Equipment and circuit grounds in motor control centers, panelboards, switchgear, and motors for proper connection and tightness.
- c. Ground bus connections in motor control centers, panelboards,

switchgear, and control panels for proper termination and tightness.

- d. Effective transformer core and equipment grounding.
- e. Accessible connections to grounding electrodes for proper fit and tightness.

Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

2. Electrical tests:

- a. Perform fall of potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode or system.
- b. Perform the two (2) point method test per IEEE No. 81, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohms.
- c. Alternate method: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. This test shall be made by passing a minimum of test (IO) amperes D.C. current between ground reference system and the ground point to be tested. Voltage drop shall be measured and resistance calculated by voltage drop method.

3. Test values: The main ground electrode system resistance to ground should be no greater than one (1) ohm.

C. Low Voltage Cables - 600 Volts and Below:

1. Visual and mechanical inspection for:

- a. Physical damage and proper connection in accordance with single line diagram.
- b. Equipment nameplate data compliance with design plans or starter schedule.
- c. Overload heaters compliance with motor full load current for proper size.
- d. Tightness of bolted connections.
- e. Proper barrier and shutter installation and operation.
- f. Proper operation of indicating and monitoring devices.
- g. Proper overload protection for each motor.
- h. Improper blockage of air cooling passages.
- i. Proper operation of any draw out elements.

- j. Integrity and contamination of bus insulation system.
- k. Check door and device interlocking system by:
 - 1) Closure attempt of device when door is in OPEN position.
 - 2) Opening attempt of door when device is in ON or CLOSED position.
- l. Check nameplates for proper identification of:
 - 1) Equipment title and tag number with latest one-line diagram.
 - 2) Pushbuttons.
 - 3) Control switches.
 - 4) Pilot lights.
 - 5) Control relays.
 - 6) Circuit breakers.
 - 7) Indicating meters.
- m. Verify that fuse and/or circuit breaker sizes and types conform to these specifications.
- n. Verify that current and potential transformer ratios conform to these specifications.
- o. Check bus connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints.
 - 1) Ohmic value to be zero.
 - 2) Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
- p. Check operation and sequencing of electrical and mechanical interlock systems by:
 - 1) Closure attempt for locked open devices.
 - 2) Opening attempt for locked open devices.
 - 3) Key exchange to operate devices in off-normal positions.
- q. Verify performance of each control device and feature furnished as part of the motor control center.
- r. Control wiring:
 - 1) Compare wiring to local and remote control, and protective devices with elementary diagrams.

- 2) Check for proper conductor lacing and bundling.
 - 3) Check for proper conductor identification.
 - 4) Check for proper conductor lugs and connections.
 - s. Exercise all active components.
 - t. Inspect contactors for:
 - 1) Correct mechanical operations.
 - 2) Correct contact gap, wipe, alignment, and pressure.
 - 3) Correct torque of all connections.
 - u. Compare overload heater rating with full-load current for proper size.
 - v. Compare fuse, motor protector, and circuit breaker with motor characteristics for proper
 - w. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.
 - x. Cable connections torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by the manufacturer.
 - y. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - z. Color coding conformance with specifications.
 - aa. Proper circuit identification.
 - bb. Proper lug type for conductor material.
 - cc. Proper lug installation.
 - dd. Proper shield grounding on shielded instrumentation cable.
 - ee. Proper terminations.
 - ff. Proper circuit identification.
 - gg. Proper termination of neutrals and grounds for correct operation of protective devices.
2. Electrical tests:
- a. Insulation resistance tests:
 - 1) Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
 - 2) Test each conductor with respect to ground and to adjacent

- conductors per IEEE 118 procedures for 1 minute.
- 3) Evaluate ohmic values by comparison with conductors of same length and type.
 - 4) Investigate any values less than 50 megohms.
 - 5) Measure insulation resistance of each control circuit with respect to ground.
 - 6) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
 - 7) Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
 - 8) Contactor phase-to-ground and across open contacts for 1 minute on each phase.
 - 9) Starter section phase-to-phase and phase-to-ground on each phase with starter with starter contacts closed and protective devices open.
 - 10) Test values to comply with NETA ATS, Table 10.2.
- b. Overpotential tests:
- 1) Maximum applied voltage in accordance with NETA ATS, Table 7.1.2.
 - 2) Phase-to-phase and phase-to-ground for 1 minute for each phase of each bus section.
 - 3) Test results evaluated on pass/fail basis.
- c. Current injection through overload unit at 300 percent of motor full-load current and monitor trip time:
- 1) Trip time in accordance with manufacturer's published data.
 - 2) Investigate values in excess of 120 seconds.
- d. Control wiring tests:
- 1) Apply secondary voltage to all control power and potential circuits.
 - 2) Check voltage levels at each point on terminal boards and each device terminal.
 - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that connected to solid state components.
 - 4) Insulation resistance to be 1 megohm minimum.

3. Test values:

- a. Insulation resistance tests shall be performed at 1,000 volts D.C. for one-half (1/2) minute.
- b. Bolt torque levels shall be in accordance with manufacturer's specifications unless otherwise specified by manufacturer.
- c. Control wiring insulation test voltage shall be 500 V D.C. Manufacturer shall be consulted for test voltage where solid state control devices are utilized.
- d. Overload tests shall be made at three hundred percent (300%) of motor full load current. Trip times shall be in accordance with manufacturers tolerances. Values in excess of one hundred twenty (120) seconds shall be investigated.
- e. Insulation tests shall be made prior to termination.

D. Transformers:

1. General: Inspection and testing limited to motors rated 1/2HP and larger.

2. Visual and mechanical inspection for:

- a. Physical and insulator damage.
- b. Equipment nameplate information compliance with latest single line diagram and report discrepancies.
- c. Perform specific inspections and mechanical tests as recommended by manufacturer.
- d. Proper winding connections.
- e. Bolt torque level in accordance with NETA ATS, Table 10. 1, unless otherwise specified by manufacturer.
- f. Defective wiring.
- g. Proper operation of fans, indicators, and auxiliary devices.
- h. Removal of shipping brackets, fixtures, or bracing.
- i. Free and properly installed resilient mounts.
- j. Cleanliness and improper blockage of ventilation passages.
- k. Correct tap-changer ratio setting for rated output voltage under normal operating conditions.
- l. Proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.
- m. Dissolved Gas Analysis (DGA Di-electric test, and moisture content test of

oil.

3. Electrical tests:

- a. A dielectric absorption test shall be made on motor and starter circuit. Polarization index shall be determined for motor winding.
- b. A dielectric absorption test shall be made on motor winding. The thirty-sixty (30/60) second ratio shall be determined.
- c. Insulation resistance tests:
 - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7.2.3 for each:
 - a) Winding-to-winding.
 - b) Winding-to-ground.
 - 2) 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - 3) Results temperature corrected in accordance with NETA ATS, Table 7.2.4.
 - 4) Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
 - 5) Insulation resistance test results to compare within 1 percent of adjacent windings.
- d. Perform tests and adjustments for any fans, controls, and alarm functions as suggested by manufacturer.
- e. Measure secondary voltages and adjust taps as directed by Engineer.
- f. Turn to turn electrical testing for transformer integrity.
- g. Measure no load and full load running current and voltage and compare to nameplate.
- h. Observe proper operation and sequence of any reduced voltage starters.
- i. Perform vibration base line test on motors greater than 50 HP. Amplitude to be plotted vs. frequency.
- j. Perform vibration amplitude test on motors greater than 50 HP.
- k. Check all protective devices in accordance with other sections of these specifications.
- l. Perform over potential test on winding to ground.
- m. The measurement shall be made with a 1,000 volt megohmmeter; however, the precautions noted in the tests for conductor test shall also

be applied to the motors.

- n. Insulation with resistance less than 10 megohms is not acceptable.
- o. Measurements shall be recorded in a format similar to Form 26 05 08 - B, contained in this section.
- p. After start-up of each motor, the current on each phase shall be measured.
 - 1) At no load.
 - 2) At defined load.
 - 3) In-rush current.
 - 4) Use Form 26 05 08 - B.

4. Test Values:

- a. Dielectric absorption tests shall be made in accordance with test voltage listed as specified by manufacturer. Polarization tests shall be for a ten (10) minute duration. Sixty/thirty (60/30) second ratio tests shall be for a one (1) minute duration. Polarization index readings less than three shall be investigated. Sixty/thirty(60/30)second ratio readings less than 1.4 shall be investigated.
- b. Motor measured full load current shall not exceed nameplate value.
- c. Over potential test shall be made an eighty percent (80%) of twice rated voltage plus one thousand (1,000) volts.
- d. Vibration amplitudes shall not exceed values furnished by manufacturer.

E. Lighting:

- 1. Verify that the switching, including remote control is as shown.
- 2. Verify that the circuitry is in accordance with the panel schedules.
- 3. Verify that load is balanced as closely as possible.
- 4. Verify that the lighting fixtures are located to minimize obstruction of illumination by liquid-filled mechanical equipment or building structural elements.
- 5. Verify that photocell operates properly.
- 6. Replace all lamps that do not operate properly.

F. Switches:

- 1. Visual and mechanical inspection for:
 - a. Proper blade pressure and alignment.

- b. Proper operation of switch operating handle.
- c. Adequate mechanical support for each fuse.
- d. Proper contact-to-contact tightness between fuse clip and fuse.
- e. Cable connection bolt torque level in accordance with NETA ATS, Table 10.1.
- f. Proper phase barrier material and installation.
- g. Proper fuse sizes and types as shown on single line diagram.
- h. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

2. Electrical tests:

- a. Insulation resistance tests:
 - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
 - 2) Phase-to-phase and phase-to-ground for 1 minute on each pole.
 - 3) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
- b. Contact resistance tests:
 - 1) Contact resistance in microhms across each switch blade and fuse holder.
 - 2) Investigate deviation of 50 percent or more from adjacent poles or similar switches.

G. Low Voltage Cables - 600 Volts and Below:

1. Visual and mechanical inspection for:

- a. Physical damage and proper connection in accordance with single line diagram.
- b. Cable connections torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by the manufacturer.
- c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
- d. Color coding conformance with specifications.
- e. Proper circuit identification.
- f. Proper lug type for conductor material.
- g. Proper lug installation.

- h. Proper shield grounding on shielded instrumentation cable.
- i. Proper terminations.
- j. Proper circuit identification.
- k. Proper termination of neutrals and grounds for correct operation of protective devices.

2. Electrical tests:

- a. Insulation resistance tests:
 - 1) Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
 - 2) Test each conductor with respect to ground and to adjacent conductors per IEEE I 1 8 procedures for 1 minute.
 - 3) Evaluate ohmic values by comparison with conductors of same length and type.
 - 4) Investigate any values less than 50 megohms.
- b. Perform continuity test to insure proper cable connection.
- c. Measurements shall be made prior to connection of wires to any equipment. Ends of wires are to be taped with Scotch 33+ and be physically remote from all grounded surfaces by a minimum of 2".
- d. Insulation resistance measurements shall be recorded using the following table.

PANEL DESIGNATION: UL4A	LOCATION: West Closet A
-------------------------	-------------------------

CIRCUIT	LOAD	CKT. CONF.	OUTLET TEST	WIRE SIZE	AMPS	MEGOHMS
1						
2						
3						
4						
5						
6						

7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

- e. Insulation with resistance of less than 10 megohms is typically not acceptable.
- f. Insulation resistance test shall be performed at 1,000 volts dc for one-half (1/2) minute. Insulation resistance readings shall be recorded after the one-half minute time interval has elapsed.
- g. If in the opinion of the Engineer the test results are unacceptable, the Contractor will correct the installation, material or labor at no additional cost to, and to the satisfaction of, the Engineer.

3. Test values:

- a. Insulation resistance tests shall be performed at 1,000 volts D.C. for one-half (1/2) minute.

- b. Insulation tests shall be made prior to termination.

H. Dry type Transformers:

1. Visual and mechanical inspection for:

- a. Physical and insulator damage.
- b. Equipment nameplate information compliance with latest single line diagram and report discrepancies.
- c. Perform specific inspections and mechanical tests as recommended by manufacturer.
- d. Proper winding connections.
- e. Bolt torque level in accordance with NETA ATS, Table IO. 1, unless otherwise specified by manufacturer.
- f. Defective wiring.
- g. Proper operation of fans, indicators, and auxiliary devices.
- h. Removal of shipping brackets, fixtures, or bracing.
- i. Free and properly installed resilient mounts.
- j. Cleanliness and improper blockage of ventilation passages.
- k. Correct tap-changer ratio setting for rated output voltage under normal operating conditions.
- l. Proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.

2. Electrical tests:

- a. Insulation resistance tests:
 - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7.2.3 for each:
 - a) Winding-to-winding.
 - b) Winding-to-ground.
 - 2) 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
 - 3) Results temperature corrected in accordance with NETA ATS, Table 7.2.4.
 - 4) Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
 - 5) Insulation resistance test results to compare within 1 percent of

adjacent windings.

- b. Perform tests and adjustments for any fans, controls, and alarm functions as suggested by manufacturer.
- c. Measure secondary voltages and adjust taps as directed by Engineer.

I. Lighting:

1. Verify that the switching, including remote control is as shown.
2. Verify that the circuitry is in accordance with the panel schedules.
3. Verify that load is balanced as closely as possible.
4. Verify that the lighting fixtures are located to minimize obstruction of illumination by liquid-filled mechanical equipment or building structural elements.
5. Verify that photocell operates properly.
6. Replace all lamps that do not operate properly.

J. Safety Switches, 600 volts maximum.

1. Visual and mechanical inspection for:

- a. Proper blade pressure and alignment.
- b. Proper operation of switch operating handle.
- c. Adequate mechanical support for each fuse.
- d. Proper contact-to-contact tightness between fuse clip and fuse.
- e. Cable connection bolt torque level in accordance with NETA ATS, Table 10.1.
- f. Proper phase barrier material and installation.
- g. Proper fuse sizes and types as shown on single line diagram.
- h. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

2. Electrical tests:

- a. Insulation resistance tests:
 - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
 - 2) Phase-to-phase and phase-to-ground for 1 minute on each pole.
 - 3) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

- b. Contact resistance tests:
 - 1) Contact resistance in microhms across each switch blade and fuse holder.
 - 2) Investigate deviation of 50 percent or more from adjacent poles or similar switches.

K. Control Stations:

1. Visual and mechanical inspection for:

- a. Physical damage.
- b. Proper installation.
- c. Proper type and gasketing.
- d. Proper operation of pushbutton(s) and/or selector switch(es).
- e. Proper identification on nameplate.
- f. Proper control wiring:
 - 1) Compare to elementary diagram.
 - 2) Check for proper termination.
 - 3) Check for proper conductor identification.

2. Electrical tests:

- a. Control wiring tests:
 - 1) Apply proper voltage to all circuits.
 - 2) Check voltage levels at each termination.
 - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that which is connected to solid state components. Insulation resistance to be one (1) megohm minimum.
- b. Operational test by initiating control devices to affect proper operation.

L. Local Control Panel(s) – LCP

1. Visual and mechanical inspection for:

- a. Physical damage.
- b. Proper type and installation of cabinet.
- c. Proper door closure and gasketing.
- d. Proper operation of pushbutton(s) and/or selector switch(es).
- e. Compliance with elementary diagrams and manufacturer's drawings.

- f. Proper identification on nameplates.
- g. Proper labeling of all devices both inside and outside.
- h. Proper control wiring:
 - 1) Compare to elementary diagram.
 - 2) Check for proper termination.
 - 3) Check for proper conductor identification.
- i. Proper overload protection for motor(s) when its starter is included in the panel.
- j. Proper breaker size and type.
- k. Proper CT when required.
- l. Proper terminal blocks.

2. Electrical tests:

- a. Control wiring tests:
 - 1) Apply proper voltage to all circuits.
 - 2) Check voltage levels at each termination.
 - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that connected to solid state components. Insulation resistance to be one (1) megohm minimum.
- b. Operational test by initiating control devices to affect proper operation of each control signal and discrete signal loop.

M. Operating and Control System

1. Visual and mechanical inspection for:

- a. Physical damage.
- b. Proper type and installation of cabinet.
- c. Proper door closure and gasketing.
- d. Proper operation of pushbutton(s) and/or selector switch(es).
- e. Compliance with P&IDs and manufacturer's drawings.
- f. Proper identification on nameplates.
- g. Proper labeling of all devices both inside and outside.
- h. Proper control wiring:
 - 1) Compare to elementary diagram.

- 2) Check for proper termination.
 - 3) Check for proper conductor identification.
 - i. Proper terminal blocks.
 - j. Equipment in compliance with these specifications.
 - k. Operating equipment in compliance with these specifications.
 - l. Operating screens in compliance with approved manufacturer's drawings.
 - m. Annunciator screens in compliance with approved manufacturer's drawings.
 - n. Alarm logs in compliance with approved manufacturers drawings.
2. Electrical tests:
- a. Control wiring tests:
 - 1) Apply proper voltage to all circuits.
 - 2) Check voltage levels at each termination.
 - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that which is connected to solid state components. Insulation resistance to be one (1) megohm minimum.
 - b. Operational test by initiating control devices to affect proper operation.

3.5 **ADJUSTING**

- A. Subsystem Testing:
- 1. Shall occur after the proper operation of alarm and status contacts has been demonstrated and observed by the Engineer.
 - 2. Shall occur after the process and control devices have been adjusted as accurately as possible.
 - 3. It is intended that the Contractor shall adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
 - 4. After initial settings have been completed:
 - a. Each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract documents.
 - b. After the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.

5. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, blowers, etc.

3.6 DEMONSTRATION

- A. Commissioning:
 1. Commissioning shall not be attempted until all subsystems have been found to operate satisfactorily.
 2. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable.
 3. Simulation of process parameters shall be considered only upon receipt of a written request by the Contractor.
- B. Motor current tabulation report shall reflect the values occurring during commissioning.
- C. The indications of all switchgear ammeters and kilowatt meters, shall be recorded every half-hour during commissioning.

END OF SECTION

**SECTION 26 05 09
ELECTRICAL IDENTIFICATION**

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
1. Nameplates.
 2. Labels.
 3. Wire and cable markers.
 4. Conduit markers.

1.2 APPLICABLE SECTIONS:

- A. Section 26 05 00 - Electrical General Requirements.

1.3 SUBMITTALS:

- A. Submit product literature including manufacturer name, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.

PART 2 - PRODUCTS

2.1 NAMEPLATES:

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- B. Locations:
1. Each electrical distribution and control equipment enclosure.
 2. Communication cabinets.
 3. Each junction box.
- C. Letter Size:
1. 1/8" letters for identifying individual equipment and loads.
 2. 1/4" letters for identifying grouped equipment and loads.

- D. Identify control device stations, motor control equipment, process equipment and instrumentation equipment. All such devices shall be labeled with equipment served, identifying name, and circuit number with panel.

2.2 WIRE MARKERS:

- A. Manufacturers:
 - 1. 3M
 - 2. Thomas & Betts
 - 3. Panduit
- B. Description: Heat shrink tubing, imprinted, type wire markers.
- C. Locations: Each conductor at panel-board gutters, pull boxes, outlet and junction boxes, and each load connection, PLC panels, instrument panels, instruments, MCC's, etc.
- D. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number shall be indicated on project Record Drawings.
- E. Control Circuits: Control wire number shall be indicated on schematic and interconnection diagrams.
- F. Data Wiring: Address number shall be indicated on each end of conductor on the face of the outlet cover, and on the space of the patch panel.
- G. All conductor numbers and terminal block numbers shall be reflected on the CONTRACTOR submitted Record Drawings.

2.3 CONDUIT MARKERS:

- A. Manufacturers:
 - 1. Tech Products
 - 2. Thomas & Betts
 - 3. Panduit
- B. Description: 3/16" poly tag in poly tag holder. Tie wrapped to conduit.
- C. Location: Furnish markers for each conduit longer than 6 feet.
- D. Spacing: Label at each junction and terminal end.
- E. Legend: Number as indicated in contractor prepared Record Drawings.

2.4 UNDERGROUND WARNING TAPE:

- A. Description: 4" wide detectable plastic tape, colored red with suitable warning legend describing buried electrical lines.
- B. Location: Along length of each underground conduit, 12" above conduit.

2.5 LABELS:

- A. Self adhesive, plastic coated, machine printed.
- B. Manufacturer: Brother or equal.
- C. Locations:
 - 1. Convenience outlet circuit adhered to outlet faceplate showing panel and circuit number.
 - 2. Data address number to outlet faceplate and patch panel face plate.
 - 3. Light switches, indicating lighting switched panel and circuit number.
 - 4. Process wiring indicating connection point terminal block and cabinet.

PART 3 - EXECUTION

3.1 PREPARATION:

- A. De-grease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION:

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using screws.
- C. Secure nameplate to inside surface of door on panel-board that is recessed in finished locations.
- D. Identify each conduit at each end.
- E. Identify underground conduits using one underground warning tape per trench at 12" above conduit.

END OF SECTION

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**SECTION 26 05 10
EQUIPMENT FOR HAZARDOUS LOCATIONS**

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
1. Provide raceways, fittings, seal-offs, conductors, and related products for a complete and operational system for hazardous locations.
 2. For power, alarm, and control systems for equipment specified elsewhere, provide raceways, fittings, seal-offs, conductors, and related products for a complete and operational system for hazardous locations

1.2 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary General Conditions, Special Conditions, alternates, and addenda, applicable drawings, and the specifications including but not limited to the following:
1. Section 26 05 00 - Electrical General Requirements.

1.3 QUALITY ASSURANCE

- A. Comply with provisions of sections 26 05 00, Electrical General Requirements, and 26 05 19, Conductors and Cables. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. PVC Coated Rigid Steel Conduit: ANSI C80.1/NEMA RNI-1989.
- C. Liquid-tight Flexible Metal Conduit and Fittings: UL 360. Fittings shall be listed for use with raceway (Class I, Division 2 locations only).

2.2 CONDUIT BODIES

- A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Conduit, fittings, equipment, and methods shall comply with NFPA70 with area classifications as shown on drawings per NFPA80. J-boxes: Killark GRSS/GRSSA series, Seal-offs: Killark ENY/EY/EYS series, Cord Connectors: Killark ZE series.
- B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

2.3 CONDUCTORS

- A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.
- B. Conductors: Provide stranded conductors for all power, lighting, and central circuits.
- C. Conductor Material: Copper for all wires and cables.
- D. Insulation: Provide XHHW-2 insulation for all conductors.
- E. Color Coding for phase identification in accordance with Section 26 05 19 of these specifications.

2.4 CONNECTORS FOR CONDUCTORS:

- A. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

2.5 FABRICATED MATERIALS:

- A. Outlet Boxes: Provide cast steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting brackets, and with cable and conduit-size threaded hubs in bottom and sides.
 - 1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, and brackets, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

2.6 NON-FUSIBLE SWITCHES:

- A. For equipment 2 horsepower and smaller, shall be horsepower rated; toggle switch type; quantity of poles and voltage rating as indicated. For equipment larger than 2 horsepower, switches shall be fusible type.

2.7 JUNCTION BOXES:

- A. Junction boxes with screwed-on gasketed hazardous location rated covers shall be sized as shown and detailed on the drawings.
- B. Junction or pull boxes which are required but not shown shall be sized according to requirement of Articles 370 and 373 of NEC.

2.8 OUTLET BOXES:

- A. Boxes shall be provided in the wiring or raceway systems where ever required for pulling of wires, making connections, and mounting of devices or fixtures.
- B. Boxes in exposed conduit runs shall be cast metal condulets with threaded hubs installed exposed. Non-metallic boxes are not approved.
- C. Each box shall be metal and shall have the volume required by the National Electrical Code for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall be not less than 4 inches octagonal or 4 inches square except that smaller boxes may be installed as required by fixture configuration, as approved. Boxes for use with raceway systems shall not be less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be not less than 4 inches square.

2.9 MOTOR STARTERS AND CONTROLS NOT IN MOTOR CONTROL CENTER:

- A. Combination factory assembled fused disconnect and magnetic starter shall be as indicated. NEMA size as noted. Each shall be equipped with two N.O. and two N.C. auxiliary contacts and control transformer to provide 120 volt for starter controls. Enclosures shall be suitable for hazardous locations as indicated on the drawings.
- B. Remote push button control shall be "HAND-OFF-AUTO" mounted in cast-metal condulet box with threaded hubs and fitted with cover suitable for use in hazardous locations as indicated.
- C. Solid state motor overloads and Pilot devices as detailed.
- D. Manufacturers: Shall be as manufactured by one of the following:
 - 1. Cutler Hammer

2. Square "D"
3. Allen Bradley
4. General Electric

PART 3 - EXECUTION

3.1 ROUGH-IN:

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Division 8 through 44 for rough-in requirements.

3.2 ELECTRICAL INSTALLATIONS:

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials and equipment. Comply with the following requirements.
- B. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- C. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- D. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 INSTALLATION OF WIRES AND CABLES:

- A. General: Install electrical cables, wires, and connectors in compliance with NEC.
- B. Pull conductors simultaneously where more than one is being installed in the same raceway. Use UL listed pulling compound or lubricant, where necessary.
- C. Use pulling means including fish, tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.
- D. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

- E. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL:

- A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.
- B. Prior to energizing, test wires and cables for electrical continuity and for short-circuits.
- C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

3.5 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weather-tight outlets for interior and exterior locations exposed to weather or moisture.
- D. Provide threaded plugs to cap unused hubs.
- E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.
- F. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.
- G. Provide electrical connections for installed boxes. Subsequent to installation of boxes, protect boxes from construction debris and damage.
- H. Provide seal-offs as required per NEC Chapter 5.

3.6 GROUNDING:

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION

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**SECTION 26 05 19
CONDUCTORS AND CABLES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install conductors and cables as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.

1.3 QUALITY ASSURANCE

- A. MANUFACTURERS: Firms regularly engaged in manufacture of conduits and raceway systems of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
- B. STANDARDS: Comply with applicable portions of the NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

1.4 APPLICABLE SECTIONS

- A. Section 26 05 00: Electrical General Requirements.
- B. Section 26 05 08: Electrical Acceptance Tests

PART 2 - PRODUCTS

2.1 COMPONENTS

- A. 600 Voltage Conductors:
 - 1. Copper with AWG sizes as shown or required:
 - a. Minimum size shall be No. 12 except where specified otherwise.

- b. Conductors shall be stranded.
 - 1) Insulation:
 - a) Conductor Size No. 2 And Smaller: 600V type THWN or XHHW (75° C). All conductors run in underground conduits shall be XHHW.
 - b)
 - c) Conductor Size No. 1 And Larger: 600V Type XHHW-2 (90° C).
 - 2) Colors:
 - a) 120/240 V System
 - (1) Black: Line 1.
 - (2) Red: Line 2.
 - (3) Green: Ground.
 - (4) White: Neutral.
 - b) 208Y / 120 V System:
 - (1) Black: Phase A.
 - (2) Red: Phase B.
 - (3) Blue: Phase C.
 - (4) Green: Ground.
 - (5) White: Neutral.
 - c) 480Y / 277 Volt System:
 - (1) Brown: Phase A.
 - (2) Orange: Phase B.
 - (3) Yellow: Phase C.
 - (4) Neutral: Gray.
 - (5) Ground: Green.
 - d) Conductors size No. 10 and smaller shall be colored full length. Tagging or other methods for coding of conductors size No. 10 and smaller not allowed.
 - e) For feeder conductors larger than No. 10 at pull boxes, gutters, and panels, use taped band or color tag color-coded as specified above.

B. Instrumentation Cables:

1. Instrument cable shall be Type TC, and have the number of individually shielded twisted pairs indicated on the Drawings and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum. Shielded, grounded instrumentation cable shall be used for all analog and low voltage digital signals.
2. The jacket shall be flame retardant with 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.
3. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.
4. Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

C. Control Wires:

1. Copper with AWG sizes as shown or required:
 - a. Minimum size shall be No. 14 except where specified otherwise.
 - b. Conductors shall be stranded.
 - 1) Insulation:
 - a) 600V type THWN or XHHW (75° C). All conductors run in underground conduits shall be XHHW.
2. Control wires may be run in same conduits as instrumentation cables.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Conductors and cables shall be continuous from source to equipment.
2. Do not use direct burial cable.
3. Instrumentation and control wires shall be run in conduits separate from power conduits.

B. 600 Voltage Conductors:

1. Install conductors in raceway except where specifically indicated otherwise. Run conductors of different voltage systems in separate conduits. All raceways shall include an equipment ground conductor.
 2. Route circuits at own discretion, however, circuiting shall be as indicated or required. Group circuit homeruns to panels as shown on Drawings. No other groupings of circuits will be allowed.
 3. Neutrals:
 - a. On three-phase, 4-wire systems: Do not use common neutral for more than one three phase circuit.
 - b. On single-phase, 3-wire systems: Do not use common neutral for more than one circuit per phase.
 - c. Run separate neutrals for each circuit where specifically noted on Drawings.
 - d. Where common neutral is run for two or three home run circuits, connect phase conductors to breakers in panel which are attached to separate phase legs so neutral conductors will carry only unbalanced current. Neutral shall be sized at 200% of full load.
 4. Pulling Conductors:
 - a. Do not pull conductors into conduit until raceway system is complete and enclosures, cabinets, and boxes are free of foreign matter and moisture.
 - b. Install conductors in accordance with the manufacture's requirements.
 - c. Use only listed non-hardening wire pulling lubricants.
 5. Provide positive supports for conductors in vertical raceways at following spacing minimum, unless shorter is recommended by manufacturer.

a. No. 18 to 1/0	100 feet.
b. No. 2/0 to 4/0	80 feet.
c. 250MCM to 350MCM	60 feet.
d. 350MCM to 500MCM	50 feet.
- C. Feeder and branch circuits shall be isolated from each other, and from instrumentation and control circuits. Instrumentation cables shall be installed in separate raceways from other cables and wiring. This includes portions running through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards, unless otherwise shown on the Drawings.

- D. Maintain electrical continuity of the shield when splicing twisted shielded pair conductors. Drain wires shall be terminated inside enclosures at grounded terminal blocks. Only one end of each instrument loop cable drain wire shall be grounded. Ground drain wire of shielded conductors at one end only.
- E. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
 - 1. CONTRACTOR shall supply terminal boards as required.
 - 2. Do not field wire directly to devices.
- F. Low Voltage Cables In Office Spaces (70 Volts or Less):
 - 1. In inaccessible, concealed spaces, run cables in raceway. In accessible, unfinished areas, cables may be run exposed without raceway.
 - 2. Run exposed cables parallel to or at right angles to building structure lines. Do not run exposed cables on floors or in such a way that they obstruct access to, operation of, or servicing of equipment. Keep cables 6 inches minimum from hot water pipes.
 - a. Support cables every 3 feet with permanent clips, straps, staples, or tie wraps approved for application and which will not cause cables to be pinched or deformed.
 - b. Securely attach clips and straps with nails or screws. Do not use wire or tape to support cables.
 - 3. Bundle only cables of same systems together.

END OF SECTION

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SECTION 26 05 22
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install wiring devices as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

- A. Submit product literature including manufacturer, model or part number, materials of construction, size, ratings, and listings as a minimum.

1.3 QUALITY ASSURANCE

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.
- E. UL - Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell, Model HBL-1221, 1223, 1224 series.
 - 2. Arrow Hart, Model 1991.
- B. Description: NEMA WD 1, Heavy-Duty Specification Grade AC only general-use snap switch.
- C. Body and Handle: Gray plastic with toggle handle.
- D. Indicator Light: Lighted handle type switch red color handle.
- E. Locator Light: Lighted handle type switch; red color handle.
- F. Ratings:
 - 1. Voltage: 120-277 volts, AC.
 - 2. Current: 20 amperes.

2.2 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell, Model HBL 5362-SP.

2. Arrow Hart, Model 5362-CR.
- B. Description: NEMA WD 1, Heavy-duty specification grade general use receptacle.
- C. Device Body: Gray plastic.
- D. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

- A. Decorative Cover Plate: Brushed stainless steel in electrical/control/blower rooms.
- B. Process Room/Exterior Cover Plate: Gasketed cast metal with hinged gasketed device cover. Lever type switch cover. Classified hazardous as required for process areas per drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that outlet or device boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

3.3 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install devices plumb and level.
- C. Install switches with OFF position down.
- D. Install receptacles with grounding pole on bottom.
- E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- G. Connect wiring devices by wrapping conductor around screw terminal.
- H. Use jumbo size plates for outlets installed in masonry walls.

- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install wall switch 48 inches above finished floor.
- B. Install convenience receptacle 18 inches above finished floor unless otherwise indicated.
- C. Install convenience receptacle 6 inches above back-splash of counter.
- D. Install dimmer 48 inches above finished floor.
- E. Install telephone jack 18 inches above finished floor.
- F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.
- G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.

3.5 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.
- F. Verify that each telephone jack is properly connected and circuit is operational.

3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

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SECTION 26 05 24
EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SCOPE

Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

- A. This section includes wiring connections to equipment specified in other sections.
- B. Electrical connections to equipment: Provide the materials and make the electrical connections to all equipment having electrical requirements as indicated in the architectural and/or mechanical section of the specifications and drawings.
- C. Provide conduit, wiring, connect motors and other mechanical equipment and electrical devices in other sections; also install, provide, support for, and connect starters, other control devices, control panels, furnished for such motors and equipment; complete all circuit leave in satisfactory operating conditions.
- D. Provide control devices for equipment in addition to those furnished by the trades providing such equipment; refer to schedules on electrical and mechanical drawings for control devices to be furnished under scope of the electrical work.
- E. Control devices and panels furnished by trades providing equipment will be delivered to electrician at site of project; acknowledge acceptance in writing; assume responsibility for particular installation before proceeding with installing and wiring them. Follow each manufacturer's printed installation directions and wiring diagrams for installing and making connections to his equipment and controls.
- F. Consult contract drawings and specifications of trades providing equipment and controls, for control wiring diagrams, also refer to their shop drawings in order to become familiar with equipment type and operation of controls, their locations and extent of work required for installing, wiring and connecting them.
- G. Starters for all motors requiring same shall be furnished by electrical contractor.

1.2 APPLICABLE SECTIONS

The General Conditions, Supplementary Conditions, Special Conditions, alternates, and addenda, applicable drawings, and the specifications including but not limited to the following:

- A. Section 26 05 00 - Electrical General Requirements.

1.3 REFERENCES

- A. Section 01 50 00 - Quality Control:

- B. NEMA WD 1 - General Purpose Wiring Devices.
- C. NEMA WD 6 - Wiring Devices - Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

- A. Section 01 30 00 – Submittals: General.
- B. Section 26 05 00 - Submittals: Procedures for submittals.
- C. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.6 COORDINATION

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

- A. Manufacturers:
 - 1. Hubbell.
 - 2. Or equal.
- B. Attachment Plug Construction: Conform to NEMA WD 1.
- C. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: NFPA 70, Type SJO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit over-current protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energizing

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid-tight 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

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**SECTION 26 05 26
GROUNDING AND BONDING**

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
 - 1. Grounding electrodes and conductors.
 - 2. Equipment grounding conductors.

1.2 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following:
 - 1. Section 26 05 00 - Electrical General Requirements.

1.3 REFERENCES

- A. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- B. NFPA 70 - National Electrical Code.

1.4 GROUNDING SYSTEM DESCRIPTION

- A. Metal underground water pipe.
- B. Metal frame of the building.
- C. Concrete-encased electrode.
- D. Rod electrode.
- E. Plate electrode.
- F. Active electrode.

1.5 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 25 ohms maximum.

1.6 SUBMITTALS FOR REVIEW

- A. Section 01 30 00 – Submittals: General.

- B. Section 26 05 00 - Submittals: Procedures for submittals.
- C. Product Data: Provide for grounding and bonding equipment.
- D. All submittals shall include a list of all items being submitted by description, manufacturer and catalog number.

1.7 SUBMITTALS FOR CLOSEOUT

- A. Section 26 05 05 - Operation and Maintenance Manuals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.
- C. Certificate of Compliance: Indicate approval of installation by the authority having jurisdiction.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

1.9 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

- A. Material: Copper Clad Steel.
- B. Diameter: 5/8 inch.
- C. Length: 10 feet (3000 mm).

2.2 CONNECTORS

- A. Manufacturers:
 - 1. T&B
 - 2. Burndy - Hi-Ground
 - 3. ERICO® - Cadweld®
- B. Material: Irreversible Crimp Style or Exothermic Weld.

2.3 WIRE

- C. Material: Stranded copper, tinned.
- D. Grounding Electrode Conductor: Size as indicated in the Drawings, or if modified or not indicated, size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Install electrodes at locations indicated and in accordance with manufacturer's instructions. Install additional rod electrodes as required to achieve specified resistance to ground.
- B. Provide grounding electrode conductor (UFER) and connect to reinforcing steel in foundation footing. Bond steel together.
- C. Provide bonding to meet Regulatory Requirements.

3.3 FIELD QUALITY CONTROL

- A. Perform inspections and tests listed in NFPA ATS, Section 7.13.

END OF SECTION

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**SECTION 26 05 30
CONDUIT**

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install conduits and raceway systems as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.
- C. Proposed location and details of construction for openings in slabs and walls for conduit runs.

1.3 QUALITY ASSURANCE

- A. MANUFACTURERS: Firms regularly engaged in manufacture of conduits and raceway systems of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
- B. STANDARDS: Comply with applicable portions of the NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

1.4 PROJECT/SITE CONDITIONS

- A. GENERAL:
 - 1. Unless otherwise specified, equipment and materials shall be sized and derated for ambient site conditions, but in no case less than an ambient temperature of 40 degrees C at an elevation ranging from sea level to 1,601 feet without exceeding the manufacturer's stated tolerances.
- B. AREA CLASSIFICATIONS

1. For the purpose of delineating the basic electrical construction materials and installation requirements for this project, areas of the project have been classified on the contract drawings as defined below. Electrical work within these areas shall conform to the requirements described below as well as the referenced code requirements.
 - a. General Purpose (NEMA 1): Areas requiring general purpose (NEMA 1) construction are indoor areas typically architecturally finished and occupied by plant personnel or electrical rooms.
 - b. Outdoor Areas (NEMA 3R): Areas exposed to the outdoor elements such as rain, snow, wind, etc. Outdoor Areas that are corrosive (salty, outdoor wastewater, outdoor gasses) are NEMA 4X.
 - c. Corrosive Process Areas (NEMA 4X): Areas requiring corrosion resistant (NEMA 4X) construction are all outdoor areas unless noted otherwise and all indoor corrosive process areas. Corrosive process areas typically contain pumping or piping systems and are subject to spills and washdown. Corrosive process areas shall also include those areas containing corrosive chemicals or gasses including but not limited to H₂S, CL₂, fluoridation, and wastewater environments. NEMA 7 takes precedence over NEMA 4X requirements for explosive corrosive environments.
 - d. Hazardous Explosive Areas (NEMA 7): Unless otherwise indicated on the contract drawings, areas requiring hazardous location (NEMA 7) construction are classified as Class 1, Division 2 or Class1, Division 1 hazardous locations per Articles 500 and 501 of the National Electrical Code. See classification drawings.
 - e. Process Areas (NEMA 12): Areas requiring drip-proof (NEMA 12) construction are indoor process and support system areas and are not typically subject to spills, direct washdown, or corrosive chemicals under normal operating conditions.

C. CONSTRUCTION MATERIALS:

Construction materials required for each area classification are listed in table A below. Refer to the individual specification section for each component for material composition and installation practices.

Component	Area Classification				
	NEMA 1	NEMA 3R	NEMA 4X	NEMA 12	NEMA 7 ¹¹
Underground	PVC ⁴⁹ HDPE ⁴⁹	PVC ⁴⁹ HDPE ⁴⁹	PVC ⁴⁹ HDPE ⁴⁹	PVC ⁴⁹ HDPE ⁴⁹	PVC ⁴⁹ HDPE ⁴⁹
Conduit (exposed)	GRS	RA ⁷ PGRS	RA ⁷ PGRS	GRS	PGRS
Conduit (concealed) ⁴	EMT ³	GRS	RA ⁷ EMT ³	GRS	GRS
Flexible conduit ⁵	LFS	LFS	LFN	LFN	CL
Support systems ¹⁰	S	AL GS	SS, AL, NM	AL	SS
Fastening hardware and hanger rods ¹⁰	S	GS SS	SS, AL, NM	CPS	SS
Control Stations ^{2,6}	PS	PS	NM	PS	CL
Enclosures ^{2,6}	PS	PS	NM	PS	CL
Receptacles ² Surface Recessed	General General	WP ⁸ WP ⁸	WP ⁸ N/A	WP ⁸ WP ⁸	CL N/A
Switches ² Surface Recessed	General General	WP ⁸ WP ⁸	WP ⁸ N/A	WP ⁸ WP ⁸	CL N/A

Notes:

1. Enclosures, device boxes, control stations and raceway systems shall be mounted with ¼-inch (minimum) space between the electrical system and supporting structure.
2. Conduit terminations to control stations, enclosures, and device boxes in NEMA 4X, 7 and 12 areas shall be made through threaded hubs.
3. Rigid conduit concealed in framed walls, block walls and ceiling spaces shall be electrical metallic tubing, type EMT.
4. Conduit ductbank or beneath slab on grade shall be PVC-40 or HDPE-40
5. Flexible conduit shall be utilized for final connections to equipment.
6. Control station and enclosure sealing ratings shall meet or exceed the rating designated by the area classification.
7. Exposed conduit systems in areas containing equipment handling Ferric Chloride shall be PGRS.
8. Use gasketed lever type switches and up-in use red dot steel receptacle covers.
9. Use rigid or fiberglass risers from underground to above ground with risers matching the exposed conduit requirements.
10. Ensure metallic compatibility between conduit and all fasteners / supports of dissimilar metals, or maintain similar metals for all.
11. All conduit changing a classified area shall be provided with classified seal off. Class I Div 1 shall have Class I Div 1 sealant applied. Class I Div 2 shall have airtight sealant applied. Seal off to be applied on the classified side of any conduit transitioning to underground.

Legend:

EMT	Electrical Metallic Tubing
GRS	Galvanized Rigid Steel
LFS	Liquid Tight Flexible Steel
LFN	Liquid Tight Flexible Non-Metallic
PGRS	PVC Coated Galvanized Rigid Steel
PVC4	PVC Schedule 40
PVC8	PVC Schedule 80
HDPE4	HDPE Schedule 40
HDPE8	HDPE Schedule 80
RA	Rigid Aluminum
WP	Weatherproof – Use cast device boxes with threaded hubs
XP	Explosion proof – Approved conduit systems per classification listing
N/A	Non applicable
GS	Galvanized Steel
AL	Aluminum
S	Steel
SS	Stainless Steel
CPS	Cadmium Plated Steel
PS	Painted Steel
CL	Classified, matching the area classification
NM	Non-Metallic

PART 2 - PRODUCTS

2.1 CONDUIT AND TUBING

- A. GENERAL: Provide conduit and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".
- B. ELECTRICAL METALLIC TUBING (EMT):
1. Per UL "Standard for Electrical Metallic Tubing" No. 797. Galvanized mild steel with interior coat of enamel.
 2. Fitting shall be steel, compression type. Cast type or indenter type fittings are not acceptable.
 3. Approved for interior locations of the Electrical Building, and for concealed installation above ceilings and in walls for receptacle and lighting circuits.
 4. Not approved for use in classified areas or process areas of the plant.
- C. GALVANIZED RIGID METAL CONDUIT (GRC): FS WW-C-0581 and ANSI C80.1.
1. Per USAS C80.1, zinc-coated by hot-dip galvanizing or sherardizing with additional enamel or lacquer coating.
 2. Couplings shall be threaded type of same material and finish as conduit. Connectors shall be Myers hubs or equal of same material and finish as conduit.

Approved Locations: Exterior installations above ground, where not exposed to moisture or corrosive atmosphere. Elbows below concrete and risers through concrete shall be PVC Coated Ridged Conduit.
- D. POLYETHYLENE PLASTIC PIPE (PVC), SCHEDULE 40, Based on Outside Diameter: ASTM D 2447
1. Un-plasticized polyvinyl - chloride heavy wall (PVC-40).
 2. Fittings shall be threaded or solvent welded type of same material as conduit.
 3. Approved for underground direct burial, May be used where buried in earth under floor slabs. Minimum depth of bury under slab shall be 18 inches or of sufficient depth to allow for bending radius to rise out of the slab vertically. Shall have an exposed grounding electrode conductor in each trench.
 4. Threaded male plastic adapters shall be used where connected to metal conduits.
- E. POLYETHYLENE PLASTIC PIPE (PVC), SCHEDULE 80, Based on Outside Diameter: ASTM D 2447
1. Un-plasticized polyvinyl - chloride heavy wall (PVC-80).

2. Fittings shall be threaded or solvent welded type of same material as conduit.
 3. SCHEDULE 80 approved for above grade installation and for embedding in concrete slabs. Schedule 80 may be used within the process area of the plant, supported in frequent intervals, as per NEC, except elbows below concrete and risers through concrete shall be PVC Coated Ridged Conduit.
 4. Threaded male plastic adapters shall be used where connected to metal conduits.
- F. HIGH DENSITY POLYETHYLENE PLASTIC PIPE (HDPE), SCHEDULE 40, Based on Outside Diameter:
1. High density polyethylene heavy wall (HDPE-40) suitable for direct burial. 1" minimum size.
 2. Fittings shall be threaded or heat welded type of same material as conduit. No splices are allowed underground due to high probability of water in conduit.
 3. Approved for underground direct burial, May be used where buried in earth under floor slabs. Minimum depth of bury under slab shall be 18 inches or of sufficient depth to allow for bending radius to rise out of the slab vertically. Shall have an exposed grounding electrode conductor in each trench.
 4. Not approved for above grade installation nor for embedding in concrete slabs
- G. PVC COATED GALVANIZED RIGID METAL CONDUIT (PGRC): NEMA RN 1.
1. Rigid galvanized conduit, prior to plastic coating, shall conform to ANSI Standard C80.1, UL 6, and CSA Standard C22.2 #45.
 2. Nominal thickness of exterior PVC coating shall be 40 mils. A two-part red urethane coating of 2 mil thickness shall be applied to the interior of all conduits and fittings.
 3. All hollow conduit fittings which serve as part of the raceway system shall be coated with exterior PVC coating and red interior urethane coating as described above.
 4. Coated conduit shall conform to NEMA Standard No. RN1-1989. Shall be "Plastic-Bond Red" as manufactured by Robroy Industries, Inc or equal.
 - a. Approved Locations: Shall be used in all locations where conduits are buried, in contact with earth, and in wet and corrosive areas of the plant, and as noted on the drawings. All buried conduit between VFDs and motors. All risers through concrete floors.
 5. Taping or double taping of GRC is not considered an equal installation as the interior of the conduit shall also be coated.
- H. LIQUIDTIGHT FLEXIBLE METAL CONDUIT: UL 360.
1. Galvanized steel with an extruded liquidtight PVC cover that is moisture and oil-proof, and UV resistant.

2. Fittings shall be liquidtight compression type, listed for grounding and listed to match the classification. Provide fittings with external bonding jumper where required for bonding.
3. Approved for flexible connections to equipment subject to vibration such as motors, fan, pumps, dry transformers, etc., 36-inch maximum, 18" minimum length for each connection.

I. FLEXIBLE METAL CONDUIT: UL 1.

1. Galvanized steel.
2. Approved for flexible connections to equipment in unclassified NEMA 1 areas not including electrical rooms.

J. RIDGED ALUMINUM CONDUIT:

Couplings shall be threaded type of same material and finish as conduit. Connectors shall be Myers hubs or equal of same material and finish as conduit.

Approved Locations: Interior where exposed, on the exterior exposed to moisture or corrosive atmosphere. Approved for above grade installation. May be used within the process area of the plant.

K. CONDUIT BODIES:

1. Form 7 malleable iron with hot dip galvanized finish, PVC coated in wet or process areas of plant.
2. Gasketed cast iron, zinc plated cover with stainless steel screws.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

- A. General Requirements: Unless otherwise indicated, wiring shall consist of insulated conductors installed in conduits or raceways.

3.2 CONDUIT AND TUBING SYSTEMS

- A. Conduit and tubing systems shall be installed as indicated. Conduit sizes are based on the use of insulated, copper conductors. Minimum size of raceways shall be as noted. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. PVC coated rigid metal conduit will be used in damp, wet or corrosive locations and the conduit or tubing system will be provided with the appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Any exposed threads or metal shall be touched up with 3 coats of touch up material provided with conduit. Raceways shall be kept 6" away from parallel runs of any mechanical piping. Raceways shall be concealed where possible. Raceways crossing structural expansion joints shall be provided with suitable expansion fittings and will provide continuity for grounding.

3.3 BELOW SLAB-ON-GRADE OR IN THE GROUND

- A. All electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing through slabs-on-grade shall be PVC coated rigid metal conduit. PVC conduits shall be installed below slab-on-grade or in the earth. All underground bends over 22° and risers through concrete slab shall be PVC coated GRC.

3.4 INSTALLED IN SLABS INCLUDING SLABS ON GRADE

- A. Conduit shall not be embedded in concrete slabs except as specifically detailed.

3.5 EXPOSED RACEWAYS

- A. Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above ceilings shall be considered as exposed installations.

3.6 CHANGES IN DIRECTION OF RUNS

- A. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field made bends and offsets shall be made with an approved hickey or conduit bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp or wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed from obstructions or shall be replaced.

3.7 SUPPORTS

- A. Metallic conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 10' and within 3' of boxes, cabinets, enclosures, and fittings, with U-channel support systems, one hole conduit straps with clamp backs, and conduit hangers. All supports mounted in exterior, process, or exposed areas subject to corrosive atmosphere shall be stainless steel. Supports in other areas shall be hot dipped galvanized. C-clamps or beam clamps shall have strap or rod type retainers. Rigid plastic conduits (if permitted as wiring method) shall be supported as indicated above, except that they shall be supported at 3'-0" maximum on centers and as indicated in the NEC (NFPA 70). Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging.
- B. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a power charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or supports shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4" in concrete joints shall avoid cutting the main reinforcement bars. Holes not used shall be filled. In partitions of light steel construction, sheet metal screws shall be used. Conduits shall not be supported using wire or nylon ties.
- C. Raceways shall be installed as a complete system and shall be independently supported from the structure. Upper raceways shall not be supported of lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports.
- D. Support Installations:
1. U-channel supports generally are not detailed but must be adequate to support combined weights of conduit and conductors.
 2. Clamps: Galvanized malleable iron one-hole straps with clamp backs, beam clamps or other approved device with necessary bolts, expansion shields. Perforated metal straps shall not be used.
 3. Adjustable U-channel Supports: Used to support horizontal runs only, use trapeze hangers for parallel runs of conducts.
 4. Surface mounted raceway bases shall be anchored to ceiling members or block walls on 5'-0" centers maximum spacing and at all junction and device boxes and at angle fittings. Anchors shall be: Expansion shields on concrete or solid masonry, toggle bolts on hollow masonry units or on suspended ceilings.

3.8 INSTALLATION OF RACEWAYS AND FITTINGS:

- A. General:

1. All Conduit: In accordance with requirement of National Electrical Code and applicable local codes.
 2. Steel Conduit: In accordance with recommendations of American Iron and Steel Institute "Design Manual on Steel Electrical Raceways," latest edition.
- B. Electrical Continuity:
1. All metallic conduit systems shall be electrically continuous throughout.
- C. Moisture:
1. All conduit systems shall be essentially moisture tight.
- D. Alignment of Exposed Conduit:
1. Parallel with or at right angles to lines of structure.
- E. Field Cuts and Threads:
1. Cuts shall be square, threads clean and sharp. Remove sharp or rough edges by reaming burrs. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of rigid steel conduit. Apply coat of red lead, zinc chromate or special compound recommended by manufacturer of conduit where conduit protective coating is damaged.
- F. Bends:
1. Uniform, whether job-fabricated or made with standard fittings or boxes. Do not dent or flatten conduit.
 2. Exposed Conduit: Symmetrical insofar as practicable.
- G. Location:
1. Routing: Generally shown in schematic fashion, unless dimensioned or noted to contrary. Contractor shall determine actual routing as approved.
 2. Conduit Not Shown: Contractor shall route as required to connect equipment as specified.
 3. Vertical Risers, Equipment and Device Locations: Approximately as shown. Contractor shall coordinate installation of conduit, in locations indicated, with structure and equipment.
 4. Conduit in Relation to Steam or Hot Water Lines or Other Hot Surfaces: Locate minimum of 6" away. If such separation is impracticable, protect from heat as approved.
- H. Buried Conduit:

1. Depth of Burial: Minimum of 24" below finished grade with warning tape 12" above conduit.
- I. Wall Penetrations: Required for passage of conduits installed by CONTRACTOR through walls, or partitions.
1. Penetrations Through Exterior Building Walls: Cast in sleeve/Core drill wall and provided conduit entrance seals as detailed. All penetrations shall be with rigid steel conduit PVC coated within the plant process areas.
 2. Openings Required Through Existing Partitions: Shall be provided at CONTRACTOR's expense. Holes through masonry construction shall be cast/ drilled with suitable coring machine. Perform work neatly. Patches shall match original material in composition and appearance.
 3. Provide fire seals where a fire rated partition or wall is penetrated.
- J. Expansion Fittings:
1. Install in all conduit runs crossing structural expansion joint or in straight runs 75 feet or more in length.
- K. Conduit Ends:
1. Cap spare conduits.
 2. Open Conduit Ends Terminating in Switchboards, Cabinets or Similar Locations Where Exposed to Entrance of Foreign Material: Install insulating grounding bushing. Plug space around cables with sealing compound.
 3. Cap or plug conduit ends to prevent entrance of foreign material during construction.
- L. Conduit Connections:
1. Cabinets, Enclosures, and Boxes: Double lock nuts and insulating bushings for rigid conduits in unclassified areas, NEMA 1. Hubs for rigid conduits in damp, wet, exterior, or corrosive areas, NEMA 12, 3R, 4, 4X. Bushings, insulating type, bell ends, or insulated throat fittings shall be installed on the ends of all conduits. Grounding type fittings and bushings shall be utilized as required for bonding.
 2. Metallic Conduit Terminating in Non-Metallic Manholes or Pull Boxes: Insulated grounding bushing with lay-in ground lugs.
 3. Flexible conduit for connection to movable equipment shall be liquidtight, utilizing listed liquidtight fittings.
- M. Cleaning:
1. Clean and swab inside of conduits by mechanical means to remove foreign materials and moisture before conductors are installed.

N. Spare Conduits:

1. Install nylon pull line for future installation of cables. Cap all conduits and mark where end is located on Record Drawings with dimensions.

END OF SECTION

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SECTION 26 05 34
ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install electrical boxes and electrical fittings as required, and as shown on the Drawings. Materials employed shall be as indicated on the specified herein.
- B. Types of electrical boxes and fittings in this section include the following:
 - 1. Outlet boxes
 - 2. Junction boxes
 - 3. Pull boxes
 - 4. Conduit bodies
 - 5. Bushings
 - 6. Locknuts and hubs
 - 7. Knockout closures
 - 8. Miscellaneous boxes and fittings.

1.2 SUBMITTALS

- A. Submit product literature including manufacturer, model or part number, materials of construction, size, ratings, and listings as a minimum.

1.3 QUALITY ASSURANCE

- A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings.
- B. Comply with ANSI C 134.1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxed, covers and box supports. Provide electrical boxes and fittings, which have been UL listed and labeled.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

- A. Flush Interior Outlet or Device Boxes: Provide one piece, galvanized flat rolled sheet steel interior wiring boxes of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices; minimum depth 1-1/2". Provide minimum 2-1/8" depth for boxes with three or more conduit entries.

- B. Interior Outlet or Device Box Accessories: Provide box accessories as required for each installation, including mounting brackets, hangers, extension or plaster rings, fixture studs, cable clamps and metal straps for supporting boxes, which are compatible with boxes being used and fulfilling requirements of individual wiring applications.
- C. Exposed Outlet or Device Boxes: Provide corrosion-resistant cast-metal type FD weatherproof wiring boxes of types, shapes and sizes (including depth) required, with integral threaded conduit hubs, face plates with spring-hinged waterproof caps suitable configured for each application, with face plate gaskets and corrosion-resistant fasteners.
- D. Junction and Pull Boxes: Provide junction and pull boxes with covers of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless hardware. Provide underground concrete junction boxes as required or indicated on the Drawings. Provide cast steel boxes with threaded hubs and gasketed cover as required or indicated on the Drawings.
- E. Conduit Bodies: Provide galvanized cast-metal Form 7 conduit bodies of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.
- F. Bushings, Knockout Closures, Locknuts, and Hubs: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and hubs, and conduit bushings and offset connectors of types, and sizes to suit respective uses and installation.
- G. All boxes, fittings, and conduit bodies shall be PVC coated wherever PVC coated conduits are required elsewhere in this specification.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:

- A. General: Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
- C. Provide cover plates for all boxes. See Section 26 05 22, Wiring Devices.
- D. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.
- E. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- F. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface.

- G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them.
- H. Provide electrical connections for installed boxes.

END OF SECTION

**SECTION 26 09 13
CONTROL DEVICES**

PART 1 - GENERAL

1.1 SCOPE

- A. This section sets forth the general specification and requirements for the control devices that shall be provided with control panels, motor starters, and other enclosures in order to assemble a complete and operable control, alarm, or indicating system.
- B. The SUPPLIER shall coordinate the installation of items specified herein as required to ensure the complete and proper interfacing of all the components and systems.

1.2 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary General Conditions, Special Conditions, alternates and Addenda, applicable drawings and the technical specification herein shall apply to work under this Section.

1.3 APPLICABLE REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1985; Incl. Rev. 1 and 2; ICS-6) Enclosures for Electrical Equipment

NEMA ICS 1 (1988) General Standards for Industrial Controls and Systems

UNDERWRITERS LABORATORIES, Inc. (UL)

UL 50 Enclosures for Electrical Equipment

UL 508 Industrial Control Equipment

1.4 SUBMITTALS

- A. Provide complete submittal information for the control devices in accordance with Section 26 05 00.
- B. Comply with the following requirements:
 - 1. Submit certified dimensional drawings and manufacturer's data sheets for each size and type of device specified herein to be utilized. Data sheets are to be highlighted to define the specific materials of construction and features specified herein along with detailed manufacturer's model number.

2. Submit instruction bulletins for each type of control device. The instruction bulletins shall include installation instructions, wiring diagrams, power requirements, maintenance instructions, calibration instructions, and any other details of a specialized nature to the devices furnished.
- C. Additional submittal requirements:
1. Circuit Breakers and/or fuses:
 - a. Provide a complete schedule showing load and rating of circuit breakers and/or fuses.
 2. Control power transformers and/or power supplies:
 - a. Provide complete sizing calculations in accordance with the requirements identified herein.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Named manufacturers have been indicated for various specified devices to establish the standard of quality and performance of the equipment to be supplied.
- B. Devices of a given type shall be of the same model, class, or rating, have the same general appearance, and be from the same manufacturer.

2.2 GENERAL REQUIREMENTS

- A. Analog measurements and control signals shall:
 1. Be electrical as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted.
 2. Electrical signals outside control panels shall be 4 to 20 mA DC, except as noted.
 3. Signals within enclosures may be 1 to 5 VDC, or 0-10 VDC.
 4. Dropping resistors shall be installed at all field side terminations in the control panels to ensure loop integrity.
- B. Control panels provided with integral power supplies and control power transformers shall be configured to match the voltage and current requirements of the loads.
- C. Each control loop or instrument shall have an individual circuit breaker or fuse within its respective control panel and clearly identified for function.
- D. Each PLC output shall have its own individual fuse external of the I/O card, with blown fused indication.
 1. Size external fuse to open before any I/O card mounted fuses.
- F. Signal isolators, Signal Converters, and Power Supplies:

1. Signal isolators shall be furnished and installed in each measurement and control loop, wherever required:
 - a. To ensure adjacent component impedance match.
 - b. Where feedback paths may be generated.
 - c. To maintain loop integrity when the removal of a component of a loop is required.
2. Signal converters shall be included where required to resolve any signal level or signal type incompatibilities.
3. Power supplies shall be included, as required by the device manufacturers' load characteristics, to ensure sufficient power to each loop component.

2.3 CONTROL DEVICES

A. Signal Isolators and Converters.

1. Signal isolators shall have complete isolation of input, output and power input.
 - a. Signal input shall be 4-20 mA into 50 ohms, maximum.
 - b. Signal output shall be 4-20 mA into 1000 ohms, minimum.
 - c. Power input shall be 120 VAC, 60 Hz or 24 VDC.
 - d. Span and zero shall be adjustable.
 - e. Accuracy shall be ± 1 percent of span.
 - f. Units shall be surface or DIN rail mounted.
2. Signal Converters
 - a. Signal inputs of 1-5 V, 0-10 V, ect.
 - b. Signal output shall be 4-20 mA into 1000 ohms, minimum.
 - c. Power input shall be 120 VAC, 60 Hz or 24 VDC.
 - d. Span and zero shall be adjustable.
 - e. Accuracy shall be ± 1 percent of span.
 - f. Units shall be surface or DIN rail mounted.
3. Acceptable manufacturers:
 - a. Accromag.
 - b. AGM Electronics Model TA-4000.
 - c. Or approved equal.

B. Relays

1. General Purpose Relays:

- a. General purpose relays shall be plug-in type.
- b. Contacts rated 10 amperes at 120 volts AC.
- c. With LED indication when energized.
- d. Quantity and type of contacts shall be as shown on the Plans or as needed for system compatibility.
- e. Each relay shall be enclosed in a clear plastic heat and shock resistance dust cover.
- f. Sockets for relays shall have screw type terminals.
- g. Provide transient surge protection across the coil of each relay.
- h. Relays shall be:
 - 1) Potter and Brumfield Type KRP or KUP.
 - 2) IDEC.
 - 3) Square D Type K.
 - 4) Allen Bradley.
 - 5) Or approved equal.

2. Slave and Interposing Relays:

- a. Additional slave relays shall be provided when the number or type of contacts shown exceeds the contact capacity of the specified relays and timers.
- b. Additional relays shall be provided when higher contact rating is required in order to interface with starter circuits or other equipment.
- c. Shall be provided to compensate for voltage drop due to long wire runs.
- d. The slave and interposing relays shall be as the general purpose relays.
- e. Provide transient surge protection across the coil of each relay.

3. Time Delay Relays

- a. Time delay relays shall be pneumatic on-delay or off-delay type.
- b. Contacts shall be rated 10-amperes at 120 VAC.
- c. Units shall be including adjustable dial with graduated scale covering the time range in each case.
- d. Provide transient surge protection across the coil of each relay.
- e. As manufactured by Agastat, Series 7000.

C. Manual Operators and Interface Devices - Unclassified Areas

1. General Requirements

- a. NEMA Type 13 Oil tight.
 - b. With synthetic rubber gasket.
 - c. Heavy duty.
 - d. Industrial grade full size 1 – 13/64” diameter.
2. Pushbutton Units:
- a. Contacts rated:
 - 1) NEMA A600.
 - 2) 600 VAC maximum.
 - b. Color Code:
 - 1) Red - Stop
 - 2) Green - Start
 - 3) Orange - Open
 - 4) Blue - Closed
 - c. As manufactured by:
 - 1) Allen Bradley 800T.
 - 2) Square D Type K.
 - 3) Cutler-Hammer 10250T Series.
 - d. Furnish one spare normally open and normally closed contact with each switch.
3. Selector Switches:
- a. Contacts rated:
 - 1) NEMA A600.
 - 2) 600 VAC maximum.
 - b. As manufactured by:
 - 1) Allen Bradley 800T.
 - 2) Square D Type K.
 - 3) Cutler-Hammer 10250T Series.
 - c. Furnish one spare normally open and normally closed contact with each switch.
4. Pilot Lights:
- a. Transformer type LED pilot lights.

- b. 120 VAC.
- c. Push to Test type.
- d. As manufactured by:
 - 1) Allen Bradley.
 - 2) Square D Type K.
 - 3) Cutler-Hammer 10250T Series.

D. Manual Operators and Interface Devices - Corrosive Areas

1. General Requirements:

- a. NEMA 4X corrosion resistant.
- b. Exterior parts to be made of high impact strength fiberglass reinforced polyester or other corrosion resistant materials.
- c. Incorporating an internal neoprene boot which completely encloses all internal parts.
- e. Industrial grade full-size 1 – 13/64" diameter.

2. Pushbutton

- a. Having an integral wiping gasket around the pushbutton that cleans the wall of the pushbutton guard of any foreign material accumulation as the button is operated.
- b. Contacts rated:
 - 1) NEMA A600.
 - 2) 600 VAC maximum.
- c. Color code:
 - 1) Red - Stop
 - 2) Green - Start
 - 3) Orange - Open
 - 4) Blue - Closed
- d. As manufactured by:
 - 1) Allen Bradley NEMA 4, 4X – 800H.
 - 2) Crouse Hinds NPB1211.
 - 3) Cutler-Hammer E34 Series.
 - 4) Square D Type SK.

3. Selector Switches:

- a. Contacts rated:
 - 1) NEMA A600.
 - 2) 600 VAC maximum.
 - b. As manufactured by:
 - 1) Allen Bradley NEMA 4, 4X-800H.
 - 2) Crouse Hinds NW 12221.
 - 3) Crouse Hinds NSW 12321.
 - 4) Cutler-Hammer E34 Series.
 - 5) Square D Type SK.
 - c. Furnish one spare normally open and normally closed contact with each switch.
4. Pilot lights:
- a. Transformer type LED pilot lights.
 - b. 120 VAC.
 - c. Push to test.
 - d. Light colors shall be as identified on the Plans.
 - e. As manufactured by:
 - 1) Allen Bradley NEMA 4, 4X-800H.
 - 2) Crouse Hinds NW 12221.
 - 3) Crouse Hinds NSW 12321.
 - 4) Cutler-Hammer E34 Series.
 - 5) Square D Type SK.
- E. Terminal Blocks
- 1. Din rail mounted.
 - 2. Terminal to be of the tubular screw type with pressure plate to minimize the possibility of breaking wire strands during tightening.
 - 3. Recessed terminal hardware to minimize the possibility of contact with current carrying parts.
 - 4. Molded of high dielectric material.
 - 5. Minimum rating 600 VAC, 30 amp.

6. External connections to and from all control panel must be via terminal blocks, including power, control, alarm, instrumentation, monitoring, and solenoid circuits.
 7. Individual terminals and terminal blocks shall be marked in a permanent manner with printed identification.
 8. As manufactured by:
 - a. Entrelec M 4/6
 - b. Phoenix Contact UK 5 N
 - c. Or approved equal
- F. Conductors within Control Panels
1. Single conductors shall be as follows:
 - a. Material: Soft annealed coated copper per ASTM B33 or B189.
 - b. Standard: ICEA S-19-81.
 - c. Stranded Wire - Class B.
 - d. Insulation and Coverings:
 - 1) Thickness: Per ICEA.
 - 2) Material:
 - a) No. 8 and Smaller: Type XHHW single conductor, copper power cable, moisture resistant, flame retardant thermoplastic insulation, 600 volt, 75 °C.
 - b) No. 6 and larger: Type XHHW-2 single conductor, copper power cable, heat and moisture resistant, flame retardant, thermoplastic insulation, 600 volt, 75°C.
 - e. No. 14 AWG minimum, shall be used for field control circuits, unless otherwise noted.
 - f. No. 16 AWG minimum, Type MTW shall be used for all PLC I/O connections within the panel; between I/O device and field wiring terminal blocks.
 2. Instrumentation Cable (Shielded Twisted Pair STP):
 - a. Minimum conductor size 18 AWG.
 - b. Stranded and tinned copper conductors.
 - c. Polyethylene conductor insulated.
 - d. Foil aluminum-polyester shield – 100% shielding.
 - e. Minimum 18 AWG, stranded, tinned, copper drain wire.

- f. PVC outer jacket.
- g. UL Listed, TC rated.
- h. 600 volt insulation level.

G. Wire markers:

1. Conductors within the control panel are to be permanently marked with wire numbers at each end.
2. Wire numbers are to correspond to the wire numbers indicated on the submittal drawings and are to correspond to the terminal block number to which they are attached in the control panel.
3. Markers shall be heat shrinkable tubing, imprinted type wire markers.
4. Manufacturers:
 - a. 3M.
 - b. Thomas & Betts.
 - c. Panduit.

H. Nameplates:

1. Nameplates: Engraved three-layer laminated plastic, white letters on black background.
2. Control components within the control panel shall have nameplates secured with stainless steel screws. Nameplates cannot be attached to the covers of the panel wireways.
3. The enclosure and components on the front cover or interior swing out panels shall be identified by nameplates.
 - a. Use standard manufacturer engraved nameplates for all pushbuttons, and selector switches only if color matches that specified for engraved nameplates. If not, then furnish nameplates to match colors as specified herein.
 - b. Use engraved plastic laminated nameplates for all other devices, displays, keypads, and annunciator LED's.
 - c. For NEMA 12, 4, and 4X enclosures, use an epoxy based adhesive to affix nameplates to enclosure cover.
4. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, power supply, relay, terminal strips, and the like mounted inside the panel. The nameplate nomenclature shall match the component names identified in the submittal drawings.

5. Lettering, styles, abbreviations and sizes shall be in conformance with ISA-RP-60.6 (1984) with an intended viewing distance of 3 to 6 feet for external nameplates and 1 to 2 feet for internal nameplates.
- I. Control Circuit Breakers:
1. Each 120 VAC control circuit, instrument, or loop shall be powered from an individual control circuit breaker.
 2. Din rail mounted using the same DIN rail as used for the terminal blocks.
 3. Manual ON-OFF Switch.
 4. Rated 240 VAC.
 5. Rated 2000 AIC.
 6. Current ratings as needed load served.
 7. Provide complete nameplate identifying each circuit.
8. As manufactured by:
- a. ABB
 - b. Phoenix Contact
 - c. Entrelec
 - d. Square D
- J. Fused Terminals:
1. Isolate all PLC Digital Outputs with fuses.
 2. Isolate all PLC Digital Inputs with fuses.
 3. Isolate all PLC Analog Inputs and Outputs with fuses.
 4. Coordinate fuse size to be as recommended by the manufacturers. For PLCs, the fuse size to be below internal output protection of the PLC output module.
 5. Fuses to be terminal block mounted.
 6. Furnish nameplate identifying each fused terminal.
 7. As manufactured by:
 - a. Entrelec
 - b. Phoenix Contact
 - c. Or approved equal
- K. Field / Remote Connections:
1. Field/remote connections shall be made at terminal blocks within the panel.
 2. Furnish an individual terminal block space for each wire.

- a. Two wires on one terminal block will not be allowed.
 3. Furnish an empty wire channel on the backpanel adjacent to the field/remote terminal block strip to be used to route the field/remote wires to the connection terminal blocks.
 4. Provide spare terminal blocks as specified herein.
- L. Control Voltages:
1. Control voltage shall be supplied via control circuit breakers in the panel.
 2. Control power shall be sourced from the 120V power supplied to the panel, unless otherwise noted in the Plans.
 3. AC control voltages other than that supplied shall be transformed via a control power transformer within the panel. DC control voltages shall be supplied by AC to DC power supplies, specified herein.
- M. Control Power Transformers:
1. Low impedance type.
 2. The control power transformers shall have fused over current protection on both the primary and secondary sides of the transformer.
 3. Use actual coil power factors in calculating the VA rating of the transformer. Use a power factor of 35% if power factor of coils is unavailable.
 4. Determine the continuous VA rating of the transformer based on maximum sealed VA load current from the coils of the starters, relays, and pilot lights. Maximum inrush current shall be calculated based on the maximum inrush of devices that can be energized at one time plus the load presented by the devices already energized, and the actual power factor of the loads. This maximum inrush current must not cause the secondary voltage of the transformer to fall below 85% of rated voltage when the primary voltage has been reduced to 90% of rated voltage. Based on these calculations then actual transformer size shall be the calculated value times 1.5.
- N. Transient / Surge Protection
1. Data and Signal Line Protectors to be used on each and every analog input or output, and on each and every data and signal line external connection point:
 - a. Provide electronic circuits and components from damaging surge voltage and currents.
 - b. Provide protection of signal and data lines associated with computer, data, communications, instrumentation, broadcasting, and industrial control interfaces.
 - c. Shall be used directly with EIA standard interfaces:

- 1) RS-232
 - 2) RS-422
 - 3) RS-423
 - 4) RS-485
 - 5) 4-20 mA instrumentation loops.
- d. Repeatedly provide protection against surge currents in excess of 10,000 Amps.
- e. DIN rail mounted.
- f. Cable shields shall be passed through and may be either grounded or not grounded at the protector.
- g. System:
- 1) Heavy duty multi-staged protectors.
 - 2) Solid state stage intercepts the leading edge of the surge with sub-nanosecond response time.
 - 3) Within micro-seconds, a 3-pole common chambered gas tube capable of handling 20,000 ampere lightning current operates and crowbars the surge to ground.
 - 4) The protector remains in the crowbar state until the surge has passed and line voltages return to safe levels.
- h. Location:
- 1) Place at each end of a signal line, data line, or current loop.
 - 2) In the case of daisy chain configuration, such as RS-485, protectors shall be placed at each node.
- i. Electrical Characteristics:
- 1) Surge Life:
 - a) Greater than 1000 operations with 200 Amps, 10 x 100 μ sec.
 - b) Greater than 10 operations with 10,000 Amps, 8 x 20 μ sec.
 - 2) Leakage current at rate line to ground voltage < 10 μ Amps.
 - 3) Signal/Data attenuation at maximum data rate 3 db with 600 terminations.
 - 4) Operating temperature -40°C to +60°C.
- j. As manufactured by:
- 1) Joslyn:

- a) For differential signals, such as RS-422 or RS-485, and current loops – Model 1820.
 - b) For high frequency differential signals and current loops – Model 1821.
 - c) For line to ground protection, two separate circuits, and ground referenced signals (RS-232) and 4-20 mA loops where the return wire is grounded at the protector – Model 1810.
 - d) For high frequency line to ground protection, two separate circuits, and ground referenced signals (RS-232) and 4-20 mA loops where the return wire is grounded at the protector – Model 1811.
2. Protection from inductive spikes within the control panel.
- a. Provide surge protection across all inductive coils for control relays, starters, solenoids, etc.
- O. Power Supplies: Power supplies shall convert 120 VAC $\pm 10\%$ to 24 volt DC or other DC voltages as necessary.
- 1. Power supplies shall have an excess rated capacity of 40 percent or be rated 100 watt minimum.
 - 2. The failure of a power supply shall be annunciated at the control panel and repeated to the SCADA system through a connection to PLC.
 - 3. Output regulation shall be accurate within $\pm 0.05\%$ for a 10% line change or a 50% load change and shall include remote voltage sensing.
 - 4. The power supply shall be rated for temperatures of 32 to 122 degrees F and shall be UL recognized.
 - 5. Power supplies shall have fully isolated primary and secondary coils which shall be surrounded by an insulating enclosure which shall also provide mechanical isolation.
 - 6. All power supplies shall be designed and configured as fully redundant systems so that the failure of one power supply will automatically transfer to the other power supply with no interruption in power.
 - a. The power supply failure shall supply a dry contact for connection to a PLC input for an alarm indication.
 - 7. As manufactured by:
 - a. Power One W Series.
 - b. Phoenix Contact Quint Series.
 - c. IDEC Slim Line.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Conform to all application provisions of the NEMA and UL standards, NEC and local, state, and federal codes when fabricating the equipment.
- B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.
- C. Mount components in accordance with the installation details as prepared by the manufacturers.
- D. Mount equipment so that each device is rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment within the panel.
- E. Items, components, devices, and accessories shall be mounted and anchored using stainless-steel hardware, unless otherwise noted.

3.2 SPARES

- A. Unused inputs and outputs from the PLC shall be wired to field terminal blocks and identified.
- B. Furnish one spare normally open and one spare normally closed dry contact for each push-button, selector switch, relay, etc.
- C. Furnish ten spare fuses for each type of fuse in the panel.
- D. Furnish 15 spare terminal blocks or 20% whichever is greater.
- E. Furnish five spare relays for each type used in the panel.
- F. Spare contacts of relays, switches, etc., shall be internally wired to terminal blocks.

END OF SECTION

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SECTION 26 16 00
PANELS AND CONSOLES

PART 1 - GENERAL

1.1 SUMMARY

- A. General: This section sets forth the general specifications and requirements for all the control panels and enclosures being provided under this contract.
1. Including but not limited to all:
 - a. All custom built and designed control panels.
 2. The CONTRACTOR shall furnish, supply and install all custom panels for this project in accordance Contract documents.
 3. This section also covers requirements for local control panels being supplied by the Equipment Manufacturers as part of the packaged equipment.
 - a. The CONTRACTOR shall design all interfaces between these control panels and the SCADA/PLC System.
 4. This specification covers the requirements for the fabrication of instrument panel boards or enclosures, mounting, finishing, piping and wiring of instrument equipment.
- B. Related Sections:
1. The Contract Documents are a single integrated document, and as such all Divisions and Section apply. It is the responsibility of the CONTRACTOR and its Sub-Contracts to review all sections to insure a complete and coordinated project.

1.2 PANEL FABRICATION

- A. The following paragraphs describe general fabrication requirements for the instrument panels, enclosures, and subpanels:
1. 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 copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C.

2. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG. Annunciator and indicating light circuits shall be minimum 16 AWG. Electronic analog circuits shall be 16 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.
3. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be a non-faulting and non-interrupting design with a response time of not more than 5 nanoseconds. Surge protectors shall be Transtector "ACP-I00BW", Power Integrity Corporation "ZTAS", or equal.
4. Terminal blocks for external connections shall be suitable for No. 12 AWG wire, and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the Supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits plus one ground for each shielded cable. All wiring shall be grouped or cabled and firmly supported to the panel. 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 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.
6. 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 and shall be made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel.
7. All panels shall be thoroughly cleaned, sanded, and given not less than one coat of rust-inhibiting primer both inside and out. The panel interior shall be given not less than one coat of white enamel or lacquer. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be smoothed and given not less than two coats of enamel, polyurethane, or lacquer finish. Color samples shall be submitted to the Engineer for color selection. One quart of finish color paint shall be furnished with the panels to cover future scratches.

B. FACTORY TEST

1. Panels shall be factory-tested electrically and pneumatically by the panel fabricator in the presence of the ENGINEER before shipment.

1.3 SUBMITTALS

A. Control Panel Engineering Submittals: Submit a two phase control panel engineering submittal for each and every control panel and enclosure being provided for this project.

1. Phase I shall be the Control Panel Hardware submittal which shall include but not be limited to:
 - a. Enclosure construction details and NEMA type.
 - b. Finish, including color chart for ENGINEER selection of color.
 - c. Layout.
 - d. Power circuits.
 - e. Signal and safety grounding circuits.
 - f. Fuses.
 - g. Circuit breakers.
 - h. Signal circuits.
 - i. Internally mounted instrumentation.
 - j. PLCs.
 - k. SCADA system components.
 - l. Face plate mounted instrumentation components.
 - m. Internal panel arrangements.
 - n. External panel arrangements.
 - o. Construction drawings drawn to scale which define and quantity.
 - 1) The type and gage of fabrication steel to be used for panel fabrication.
 - 2) The ASTM grade to be used for structural shapes and straps.
 - 3) Panel door locks and hinge mechanisms.
 - 4) Type bolts and bolt locations for section joining and anchoring.
 - 5) Details on the utilization of "UNISTRUT" and proposed locations.
 - 6) Stiffener materials and locations.
 - 7) Electrical terminal box and outlet locations.

- 8) Electrical access locations.
 - 9) Print pocket locations.
 - 10) Writing board locations.
 - 11) Lifting lug material and locations.
- p. Physical arrangement drawing drawn to scale which define and quantity the physical groupings comprising:
- 1) Control panel sections.
 - 2) Auxiliary panels.
 - 3) Subpanels.
 - 4) Racks.
 - 5) Cutout locations with nameplate identifications shall be provided.
- q. A bill of material which enumerates all devices associated with the control panel.
2. Phase II shall be the Control Panel Wiring Diagram submittal which shall include but not be limited to:
- a. Schematic/Elementary diagrams shall depict all control devices and circuits and their functions.
 - b. Wiring/Connection diagrams shall locate and identify:
 - 1) Electrical devices.
 - 2) Terminals.
 - 3) Interconnecting wiring.
 - 4) These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
 - c. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment.
 - 1) These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.
 - d. Control sequence diagrams shall be submitted to portray the contact positions or connections required to be made for each successive step of the control action.

3. All panel drawings shall be 22" x 34" reduced to and fully legible at 11" x 17", and submitted at 11" x 17" format size, with all data sheets and manufacturer specification sheets being 8.5" x 11".
4. The submittal shall be in conformance with NEMA Standard ICS-1-1.01, and each phase shall be submitted as a singular complete bound volume or multi-volume package and shall have the following contents.
 - a. A complete index shall appear in front of each bound volume.
 - 1) All drawings and data sheets associated with a panel shall be grouped.
 - 2) All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
 - b. Completed ISA-S20 data sheets for all instrumentation devices associated with each control panel supplemented with manufacturer specification sheets which verify the products conformance to the requirements of the Contract Documents.
 - c. A listing of spare parts in conformance with each equipment specification section.

1.4 QUALITY ASSURANCE

A. Environmental Suitability:

1. All indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designed in the Contract Documents.
2. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices to within a range equal to 20% above the minimum and 20% below the maximum of the rated environmental operating ranges.
3. Provide all power wiring for these devices.
4. Enclosures suitable for the environment shall be furnished.
5. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. All control panels and assemblies shall be labeled and listed by a nationally recognized testing laboratory.

1. Underwriters Laboratory, Inc.
2. Or equal.

1.5 DELIVERY, STORAGE AND HANDLING

- A. All panels are to be crated for shipment using a heavy framework and skids.
 - 1. The panel sections shall further be cushioned satisfactorily to protect the finish of the instruments and panel during shipment.
 - 2. All equipment which is shipped with the panel shall further have suitable shipping stops and cushioning material installed in a manner to protect instrument parts which could be damaged due to mechanical shock during shipment.

PART 2 - PRODUCTS

2.1 CONTROL PANELS

- A. The following paragraphs describe specific requirements for the control panels:
- B. CONSTRUCTION - NEMA 12 by Hoffman or equal in control room locations. NEMA 4X by Hoffman or equal in process or humid areas or outside.
 - 1. NEMA 12
 - a. Seams continuously welded and ground smooth.
 - b. Door and body stiffeners as needed to make a rigid enclosure.
 - c. Heavy gauge continuous hinge.
 - d. Oil-resistant gasket attached to door with oil-resistant adhesive. Gasket to seal against roll lip on the enclosure opening.
 - e. Internal mounting panel held in place by collar studs welded to enclosure.
 - f. Lockable door latching and handle mechanism to allow easy access to interior of enclosure and keyboard.
 - g. Panel cut-outs for instruments, devices, and windows shall be cut, punched, or drilled and smoothly finished with rounded edges.
 - 1) Reinforce around cut-outs with steel angles or flat bars.
 - 2. Large panel cutouts such as for HMIs.
 - 3. Pilot device groupings where the removed metal exceeds 50% of the available metal in an area bound by a 3" envelope around said pilot devices.
 - a. Finish.
 - 1) Interior, smooth, polyester powder coating.
 - 2) Exterior polyester powder coating gray in color.
 - a) Panels that re in the same room as, motor control centers, switchboards, etc shall be of the same color as the motor control center or switchboards so that the control panel blends into the line up.

- b. Manufacturer's standard gauge steel.
 - c. Each door to have a three-point latching mechanism and padlocking handle with rollers on the ends of the latch rods.
 - d. With heavy duty lifting eyes.
 - e. With flange mounted disconnect.
 - f. Mounting panel
 - 1) 10 gauge steel
 - 2) With stiffeners
4. Water tight corrosion resistant stainless steel
- a. NEMA 4X in design, dust tight, water tight, and corrosion-resistant.
 - b. 14 gauge, Type 304 Stainless Steel.
 - c. Captive stainless steel cover screws threaded into sealed wells.
 - d. Oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
 - e. Finish
 - 1) Cover surface and sides, unpainted, brushed finish.
 - f. Door fronts ground smooth.
 - g. Specifically designed for use with flange mounted disconnect switches.
- C. SIZE AND ARRANGEMENT - Panel dimensions and general instrument arrangement shall be as indicated on the drawings.
- D. Interconnecting wiring and wiring to terminals for external connection shall be MTW or SIS 16 AWG, stranded copper wire, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 degrees Celsius except for electronic circuits and special instrument interconnect wiring which shall be in accordance with manufacturer requirements. Provide a switched fluorescent light at every four feet of panel length.
- E. PANEL WIRING:
- 1. Power distribution wiring on line side of panel fuses minimum 12 AWG.
 - 2. Secondary power distribution wiring and wiring for control circuits: Minimum number 14 AWG.
 - 3. Annunciator and indicating light circuits: Minimum 14 AWG.

4. Electronic analog circuits within instrument and control panels: Minimum 16 AWG twisted and shielded pairs or triads rated not less than 16 volts.
5. Provide a 15 amp, 120 volt GFCI service outlet within each panel.
6. Wire Insulation Colors:
 - a. Conductors supplying 120-volts AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor.
 - b. Grounded circuit conductors shall have white insulation.
 - c. Insulation for ungrounded 120-volt AC control circuit conductors shall be red.
 - d. All wires energized by a voltage source external to the control panels shall have yellow insulation.
 - e. Insulation for all DC conductors shall be blue.
7. Wire Marking:
 - a. Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings.
 - b. These numbers shall be marked on all conductors at every terminal in accordance with Section 26 05 09.
8. For case grounding, panels shall be furnished with a ¼-inch by 1-inch copper ground bus complete with solderless connectors for all equipment ground conductors.
 - a. Refer to Division 26 – Conduit Schedule for size and number of conductors.
9. Power Supply Wiring:
 - a. Each and every loop and instrument requiring 120 VAC shall be protected by individual DIN rail mounted circuit breakers.
 - 1) The number of circuits depends on the circuit load as noted herein.
 - 2) The circuit load shall not exceed 10 amp.
 - 3) Different panel section or different process units must not use common branch circuits.
 - 4) Furnish and install DIN rail mounted circuit breakers for all individual instruments.
 - a) Circuit breakers shall be mounted on the back of the panel.

- b) Identified by a service name tag.
 - b. Each potentiometer type instrument, electronic transducer, controller or analyzer shall have an individual DIN rail mounted circuit breaker located within the control panel.
 - 1) Circuit breakers shall have plastic tags indicating instrument tag numbers.
 - 2) Individual plug and cord set power supply connections require DIN rail mounted circuit breakers ahead of the receptacle.
- 10. Furnish circuit breakers for the panel lights, and for the panel receptacle.
- 11. Alarm Wiring:
 - a. Install and wire all alarms including light cabinets, audible signal units, test and acknowledge switches and remote logic units as specified.
 - b. Interconnecting wiring to panel mounted initiating devices shall also be wired.
 - c. Where plug and cord sets are provided for component interconnection, harness and support the cables in neat and orderly fashion. Where separate wire is required, install No. 16 AWG with MTW or TFFN insulation between all components.
- 12. Signal Wiring:
 - a. Signal Wire – Non Computer Use
 - 1) Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG with MTW or TFFN insulation between all components.
 - 2) Color code for instrument signal wiring shall be as follows:
 - a) Positive (+) – Black
 - b) Negative (-) – White.
 - 3) Multiconductor cables where specified shall consist of No. 18 AWG copper signal wires twisted in pairs, pairs, with 90°C, 600 V insulation.
 - a) A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.
 - 4) Use for connections between field terminal blocks and the PLC wiring arms for analog inputs and outputs.

- b. Signal Wire – Computer Use
 - 1) Signal wires shall be similar to those for non-computer use but each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group.
 - 2) All cable shields, including thermocouple extension leads shall be terminated at a single point within the control panel.
 - 3) Continuity of the shield is to be maintained throughout the cable runs.
 - c. Multi-conductor cables, wireways and conduit shall be sized to allow for 20 percent signal wire.
13. Wiring Installation:
- a. All wires shall be run in plastic wireways.
 - b. Exception:
 - 1) Field wiring.
 - 2) Wiring run between mating blocks in adjacent sections.
 - 3) Wiring runs from components on a swing-out panel to components on a part of the fixed structure.
 - a) Wiring run from components on a swing-out or front panel to other components on a fixed panel shall be made up in tied bundles.
 - b) These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the “hinge loop” so that conductors are not strained at the terminals.
 - 4) Wiring run to front panel-mounted components.
 - c. Signal and low voltage wiring shall be run separately from power and 120 VAC control wiring.
 - 1) 120 VAC circuits shall be run through grey colored plastic wireways.
 - 2) 24 VDC circuits shall be run through white colored plastic wireways.

- d. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.
- e. Provide an empty wireway for all field wiring connections.
 - 1) 120 VAC circuits shall be run through grey colored plastic wireways.
 - 2) 24 VDC circuits shall be run through white colored plastic wireways.
- f. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the ENGINEER's review.

14. Grounding

- a. Furnish equipment ground bus with lugs for connection of all equipment grounding wires.

F. ANALOG CIRCUITS AND AC POWER CIRCUITS: Separated.

G. INTERNAL PANEL WIRING COLORS:

- a. AC Power Distribution: Red
- b. DC Power and Control: Blue
- c. Instrument: Black and white twisted shielded pair.
- d. Other and in agreement with manufacturer's wiring diagrams as stated on manufactured drawing legend.

H. SURGE PROTECTION DEVICE FOR POWER ENTRANCES: Nominal 120 volts AC with a nominal clamping voltage of 200 volts; nonfaulting and noninterrupting design with a response time of not more than 5 nano-seconds. Utilize a branch panel TVSS unit as described in Section 26 35 53.

I. TERMINAL BLOCKS FOR EXTERNAL CONNECTIONS: Suitable for specified AWG wire, rated 30 amperes at not less than 600 volts (for incoming power circuits, and for field 1/0 terminals they shall be Phoenix contact or equal as shown on the drawings); with marking strip, covers, pressure connectors, and labeled terminals, each conductor of external circuits plus one ground terminal for each shielded cable. Provide minimum 25 percent spare terminals.

- J. Group cables, and firmly support wiring to the panel. Provide minimum 8 inches clearance between terminal strips and the base of vertical panels for conduit and wiring space. Individually fuse each control loop or system, and clearly label and locate fuses or circuit breakers for maintenance.
- K. Furnish and install equipment grounding conductor in accordance with NEC 250. Provide power ground lugs. Provide signal insulated and isolated ground lugs.
- L. Nameplates on Internal and External Instruments and Devices: Materials approximate dimensions with legends as indicated on the Drawings made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer; firmly secured to panels.
- M. POWER SUPPLIES/FUSING
 - 1. Design and arrange regulated 24 volt DC power supplies for instrument loops so that loss of 1 loop does not affect more than one instrument loop or system. Provide power supplies suitable for an input voltage variation of plus or minus 10 percent. Fuse or short circuit protects the supply output.
 - 2. Selectively fuse the power distribution from multi-loop supplies so that a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Label and locate fuses for easy access.
 - 3. Output Voltage Regulation: As required by the instrument or control equipment being supplied.
 - 4. Backup power supply units shall be provided to automatically supply the load upon failure of the primary supply. Design backup supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation.
 - 5. Oversize the multi-loop supply systems for an additional 25 percent future load. Indicate failure of a multi-loop supply on the respective instrument panel or enclosure.
 - 6. Furnish and install signal repeaters for instrument loops that exceed the load impedance of the power supplies. Indicating fuses: Neon bulb type for 120 VAC circuit and glass indicating fuse type for 24 VDC circuits.
- N. SOURCE QUALITY CONTROL:
 - 1. Functionally factory test instrument and control panel items electrically and pneumatically before shipment.
- O. PANEL ACCESSORIES:

1. Manufacturers: Weidmuller SAKS; Entrelec; Phoenix Contact; Wago; or equal.
 - a. Terminal Blocks: Nickel plated copper only; DIN rail; universal foot with the following as required for the application.
 - 1) Universal type
 - 2) Feed through
 - 3) Ground
 - 4) Neutral disconnect
 - 5) Intrinsically safe
 - 6) Explosion-proof
 - 7) Fuse
 - 8) Knife disconnect
 - 9) Ground fault indicator
 - 10) Bolt connecting
 - b. Terminal Block Labeling: Each terminal and each conductor as previously specified with machine labels only.
 - 1) Manufacturers: Phoenix Contact; Entrelec; or equal.
 - a) Signal Interface Modules:
 1. Analog isolating converter
 2. Ground loop isolations
 3. Signal amplification
 4. Signal level matching
 5. 24 VDC power supply (120 VAC input)
2. Disconnect Switches:
 - a. Switches shall consist of a thermal magnetic circuit breaker with integral door operator – lockable
 - 1) Minimum 22 KAIC
 - 2) Not required for panels fed with 120 VAC or less. A nameplate must be furnished on the cover of the control panel identifying all sources of supply and foreign voltages within the control panel.
 - b. The main disconnect shall disconnect all power sources within the control panel.

- c. Sized in accordance with the NEC and total connected horsepower and associated locked rotor currents.
- d. A disconnect shall be provided for each motor controller/starter within the control panel. This disconnecting means shall disconnect power and control power to each motor controller. Each disconnect shall be equipped with a dead front operator through either the cabinet door or a dead front panel.

END OF SECTION

SECTION 26 20 00
SERVICE AND DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the Drawings.

1.2 WORK INCLUDED

- A. Electrical work required is indicated on the Drawings and specified herein and elsewhere includes, but is not necessarily limited to:
 - 1. Complete electrical distribution systems for power, control, and instrumentation as shown.
 - 2. Complete system of raceways, conductors, and equipment for all other auxiliary systems required. If noted, the equipment and wiring of these auxiliary systems will be furnished and installed under their respective sections; however, the conduit or raceway systems will be furnished and installed in accordance with Division 26 05 00.
- B. The CONTRACTOR shall furnish and install all component parts of all the systems required for their safe and proper operation, whether or not specifically mentioned or noted on the Drawings, except those items or articles which are specifically noted as being supplied otherwise.
- C. Perform all trenching and backfilling required in connection with the work which shall be in strict accordance with the provisions of Division 31 of these specifications.
- D. Provide all required electrical conduits, conductors, and connections to items described in all other sections of these specifications.

1.3 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary Conditions, Special Conditions, Alternates and addenda, applicable drawings and the technical specifications herein shall apply.
- B. Section 26 24 17 – Distribution Panelboards.

1.4 ELECTRICAL SERVICE

- A. New underground electrical service(s) from the local utility shall be at 480/277 volt, three phase, four wire, 60 hertz AC with current ratings as indicated on the Drawings.
- B. The installation shall be in accordance with the utility company's published requirements. The CONTRACTOR shall coordinate the installation with the utility.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of the service entrance sections shall be in accordance with the manufacture's requirements.

3.2 INSTALLATION OF GROUNDING ELECTRODE SYSTEM

- A. The service entrance section shall be bonded to the grounding electrode system (GES). The GES consists of, but not limited to, the metal underground water pipes, metal frame of the building or structure, concrete encased electrode (UREF), ground rings, rods, pipe, or plate electrodes, and other metal underground systems or structures as in compliance with the NEC. Provide bonding jumper same size as system ground to provide ground continuity from customer's side of metallic lines service entrance and street side of metallic mains. The neutral (grounded conductor) and grounding electrode system shall be connected together at the service disconnect only.
- B. The UFER ground system consists of a bare copper conductor, size as indicated in the Drawings, concrete encased 2" above the bottom of the foundation footing of the building or structure which is in direct contact with earth. The UFER ground will make a complete loop in the foundation and is bonded to the rebar steel at least in two locations. UFER ground connections shall be exothermic welds.
- C. The equipment grounding system shall be such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with the electrical circuits operate continuously at ground potential and provide a low impedance path for the possible ground fault currents. The system shall comply with the National Electrical Code, modified as indicated on the Drawings or specifications.
- D. The distributions system shall be provided with a separate equipment grounding conductor for each single or three-phase feeder, each branch circuit, each motor circuit, control or instrument raceways as indicated. The grounding conductor shall be installed in the common raceway with the related phase and/or neutral conductors. Flexible conduit equipment connections utilized in conjunction with branch circuits or feeders shall be provided with suitable bonding jumpers connected to listed grounding type fittings when required.

3.3 TESTING

- A. General: Upon completion of this portion of the work, test all parts of the electrical system in the presence of the ENGINEER.

- B. Test Requirements: All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the manufacturers.

3.4 FINAL INSPECTION

- A. The CONTRACTOR shall be present at the final acceptance of the work by the OWNER.
- B. The CONTRACTOR shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the inspection, not during.
- C. See Section 26 05 00 for other requirements for final acceptance.

END OF SECTION

**SECTION 26 22 00
DRY TYPE TRANSFORMERS**

PART 1 - GENERAL

1.1 SCOPE

- A. This Section consists of dry type transformers and related items necessary to complete the work indicated within the Contract Documents.

1.2 REFERENCES

- A. NEMA ST 1 – Specialty Transformers (Except General – Purpose Type).
- B. NEMA ST 20 – Dry Type Transformers for General Applications.
- C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).
- D. NFPA 70 – National Electrical Code.
- E. UL – Underwriters Laboratories, Inc.

1.3 SUBMITTALS

- A. In accordance with Section 26 05 00.
- B. Product Data: provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type and rated temperature rise.

1.4 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

2.1 DRY TYPE TRANSFORMERS

- A. Transformers shall be premium high efficiency quiet type with copper windings, and shall be installed where indicated on the Drawings. The primary winding of the transformers shall have two 2-1/2 percent taps above, and below normal.

- B. The transformers shall have a BIL of 10 KV with a temperature class of 185 degrees C for transformers up to 25 KVA, and a temperature class of 220 degrees C for larger transformers.
- C. The sound level shall not exceed 44 dBa measured at 5 feet from the transformer after installation. Core and coil assemblies 30 KVA and larger, shall be mounted on rubber vibration isolators, designed to reduce harmonics generated noise.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 feet minimum length for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- D. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- E. Mount trapeze-mounted transformers as indicated.
- F. Provide grounding and bonding in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.2.

3.3 ADJUSTING

- A. Adjusting installed work.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

**SECTION 26 24 16
BRANCH CIRCUIT PANELBOARD**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting and Appliance Panelboard - Furnish and install lighting and appliance panelboard(s) as specified herein and where shown on the associated schedules drawings.

1.2 REFERENCES

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

- A. NEMA PB 1 – Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- E. UL 50 - Enclosures for Electrical Equipment
- F. UL 67 – Panelboards
- G. UL 98 - Enclosed and Dead-front Switches
- H. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- I. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
- J. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
- K. Federal Specification W-P-115C - Type I Class 1
- L. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
- M. NFPA 70 - National Electrical Code (NEC)
- N. ASTM - American Society of Testing Materials

1.3 SUBMITTAL AND RECORD DOCUMENTATION

- A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable

voltage systems.

1.4 QUALIFICATIONS

- A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.
- B. Panelboards shall be manufactured in accordance with standards listed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.6 OPERATIONS AND MAINTENANCE MATERIALS

- A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- B. Refer to Sections 26 05 00 and 26 05 05 for additional requirements.

1.7 WARRANTY

- A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

1.8 RELATED WORK

- A. Section 26 35 53 – Transient Voltage Surge Suppression

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D Company Type NF - Class 1670.
- B. Cutler Hammer / Eaton.
- C. General Electric.

2.2 LIGHTING AND APPLIANCE PANELBOARD TYPE

- A. Fabrication:

1. Interior
 - a. Continuous current ratings, as indicated on Drawings, not to exceed 600 amperes maximum for main breaker panelboards and not to exceed 800 amperes for main lug panelboards.
 - b. Minimum Short Circuit Rating: as indicated on the Drawings.
 - c. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be plated copper. Bussing rated for 600 and 800 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
 - d. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
 - e. A solidly bonded copper equipment ground bar shall be provided.
 - f. Split solid neutral shall be plated and located in the mains compartment up to 250 amperes so all incoming neutral cable may be of the same length.
 - g. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.
 - h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
 - i. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 125A interiors shall be vertically mounted. Main circuit breakers over 125A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.
 - j. Interior phase bus shall be pre-drilled to accommodate field installable options. (i.e., Sub-Feed Lugs, Sub-Feed Breakers, Thru-Feed Lugs)
 - k. Interiors shall accept 125 ampere breakers in group mounted

branch construction.

2. Main Circuit Breaker

- a. Shall be bolt-on type circuit breakers.
- b. Main circuit breakers shall have an over center, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true RMS sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.
- c. Two and three pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
- d. Circuit breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
- e. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
- f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.
- g. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

3. Branch Circuit Breakers

- a. Shall be Square D type circuit breakers. Circuit breakers shall be UL Listed with ampere ratings, interrupting ratings, and number of poles as indicated on the panelboard schedules drawings.
- b. Molded case branch circuit breakers shall have bolt-on type bus connectors.

- c. Circuit breakers shall have an over center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
- d. There shall be two forms of visible trip indication. The circuit breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.
- e. The exposed faceplates of all branch circuit breakers shall be flush with one another.
- f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16.
- g. Breakers shall be UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.
- h. Breaker shall be UL Listed with the following ratings: (15-125A) Heating, Air Conditioning, and Refrigeration (HACR), (15-30A) High Intensity Discharge (HID), and (15-20A) Switch Duty (SWD)

4. Enclosures

a. Type 1 Boxes

- 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
- 2) Boxes shall have removable end walls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
- 3) Box width shall not exceed 26" wide.

b. Type 1 Fronts

- 1) Front shall meet strength and rigidity requirements per UL 50 standards. Shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
- 2) Fronts shall be hinged 1-piece with door. Mounting shall be surface as indicated on associated drawings. All covers shall be hinged cover type.
- 3) Panelboards rated 250 amperes and below shall have

MONO-FLAT fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated above 250 amperes shall have vented fronts with concealed door hinges. Doors on front shall have rounded corners; edges shall be free of burrs.

- 4) Front shall have flat latch type lock with catch and spring loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

c. Type 4, and 12

- 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
- 2) All doors shall be hinged cover type. All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59 inches or more in height. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.
- 3) Maximum enclosure dimensions shall not exceed 21" wide and 9.5" deep.

5. Surge Protective Device

- a. Integral Surge Suppressor shall be provided for each branch circuit panelboard. See Section 26 35 53 for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

3.2 FIELD QUALITY CONTROL

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.

- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.3 INSTALLATION OF PANELS

- A. Installation: Unless otherwise indicated on the drawings, install wall panels with the top of the trim 6'-0" above the finished floor. Panels located in equipment rooms and wire closets shall be surface mounted. Floor mounted panels shall be provided with a 4" concrete housekeeping pad. Floor mounted panels shall be anchored to floor at all four corners and to wall or structural member at top for seismic restraint.
- B. Directories: Mount a typewritten directory behind glass or plastic on the inside of each panel door. On the directory, show the circuit number and complete description of all outlets with specific locations on each circuit. In addition, provide a typewritten label inside door showing source of power to panel both as to feeder switch, panel designation and location within buildings.

END OF SECTION

**SECTION 26 24 21
MOTOR STARTERS**

PART 1 - GENERAL

1.1 SCOPE

Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

- A. Motor Control Systems.

1.2 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications herein shall apply to all work under this Division 16, including but not limited to the following:
 - 1. Section 26 05 00 - Electrical General Requirements
 - 2. Section 26 28 13 – Fuses
 - 3. Section 26 05 26 – Grounding and Bonding
 - 4. Section 26 09 13 – Control Devices
- B. The CONTRACTOR shall be familiar with all sections of these electrical specifications. He shall adapt his work to the work required of other trades to affect a complete and working system. Where this CONTRACTOR furnishes equipment, materials or installation which comprises a part of another CONTRACTOR's system, the item so furnished shall meet or exceed the requirements imposed on the other systems.

1.3 SHOP DRAWINGS/SUBMITTALS

- A. Furnish complete working shop drawings of all control systems. Reference design documents for sequence, basic components, suggested piping, wiring, and dimensions. Submit manufacturer's data sheets for all equipment, devices and materials.
- B. After initial review, make corrections requested and resubmit in clean format. Work only from final review set.
- C. Maintain Record Drawings in the field. Clean up originals at completion of work and resubmit for OWNER's use in operation of the systems.

1.1 CONTROL DIAGRAMS

- A. Control diagrams indicating the general control strategy are as shown on the Drawings. Actual circuitry will vary for the specific equipment furnished. Pilot light push-to-test wiring was omitted from the control diagrams for clarity.
- B. Clarification of any function or device of any system not fully understood or recognized as being undefined should be requested from the ENGINEER during the bidding period.

1.4 CLEANING AND LUBRICATION

All equipment shall be thoroughly cleaned by the CONTRACTOR before final acceptance. The CONTRACTOR shall provide lubrication for all equipment furnished by him.

1.5 TESTING AND ADJUSTING OF SYSTEM

- A. During the testing and adjusting of the various electrical, control, and instrumentation systems, the CONTRACTOR shall have a representative present and available to adjust controls as required. The integrity and accuracy of each function and control point shall be demonstrated and reported.

1.6 CODES AND STANDARDS

- A. The following standards shall be considered to be part of this specification insofar as they give definitions and describe requirements and tests which equipment supplied shall meet. They shall be the latest edition, including any addenda, supplements, or revisions thereto, in effect at the time of award of the purchase order. The equipment shall also meet any laws or requirements of the city, state or other regulatory bodies having jurisdiction over such apparatus, unless otherwise specified.

- | | | |
|----|------------------|--|
| 1. | ANSI C57.13 | Requirements for Instrument Transformers
ANSI C89.1 (NEMA ST1) Specialty
Transformers (except General Purpose Type) |
| 3. | NEMA AB-1 | Molded Case Circuit Breakers
NEMA ICS1 General Standards for
Industrial Control and Systems
NEMA 1CS2 Industrial Control
Devices, Controllers and Assemblies |
| 6. | ANSI C1 (NFPA70) | National Electrical Code
UL 489 Molded Case Circuit
Breakers and Circuit Breaker Enclosures |
| 8. | UL 508 | Industrial Control Equipment |

- | | |
|-------------|---|
| 9. UL 845 | Standard for Motor Control Centers |
| 10. UL 1053 | Ground Fault Sensing and Relaying Equipment |
| 11. MSHA | Mine Safety and Health Administration |

PART 2 - PRODUCTS

2.1 MOTOR CONTROLS NOT IN MOTOR CONTROL CENTERS

- A. Furnish NEMA 4X stainless steel with gasketed hinged door control cabinets to protect and conceal all control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at labeled terminal blocks. Provide engraved plastic labels for all panel face devices.

2.2 MOTOR STARTERS NOT IN MOTOR CONTROL CENTER

- A. Furnish stainless steel with gasketed hinged door control cabinets to protect and conceal all control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at terminal blocks. Provide engraved plastic labels for all panel face devices.
- A. Combination magnetic starters shall be sized as indicated on the Drawings and shall be equipped as follows:
1. Motor Circuit Protector.
 2. NEMA contactor rating indicated, NEMA size 1 minimum.
 3. Control power transformer sized per load installed plus 50% spare capacity. Shall include fused primary and secondary.
 4. Solid state overload relay – SymCom Motor Saver 777, Square D Motor Logic Plus, or Ge Multilin, Allen Bradley or equal.
 5. Pilot devices and controls as shown on Drawings.
 6. NEMA rated enclosure as shown on the Drawings.
- C. Manual motor starters shall have:
1. ON pilot light.
 2. Overload Protection: Melting alloy type thermal overload relays where indicated or required.
 3. NEMA rated enclosure as shown on the Drawings.

PART 3 - EXECUTION

3.1 WIRING

- A. All control wiring, 120 volt and below, shall be installed in conduit and wiring boxes.
- B. Use no wiring smaller than #14 AWG and no conduit smaller than ¾ inch.

3.2 SPARES

- A. Provide one spare manual motor for each size and type used.
- B. Provide one NEMA size 1 contactor.

END OF SECTION

**SECTION 26 26 00
TERMINAL BLOCKS**

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. This section covers terminal blocks for control and other wiring.

1.2 SUBMITTALS:

- A. Products shall be submitted in accordance with Section 26 05 00, and elsewhere in the Contract Documents, prior to installation.

1.3 MANUFACTURERS:

- A. Terminal blocks shall be Entrelec, Phoenix Contact, Weidmuller, or equal.
- B. Surge protection blocks shall be MTL Surge Technologies, Series SD, or equal.
- C. Power distribution blocks shall be IlSCO Corporation, or equal.

PART 2 - PRODUCTS

2.1 TERMINAL BLOCKS:

- A. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25 percent spares shall be provided in each terminal box. No more than 2 conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power and signal commons. Terminal blocks shall be U.L. rated for 600 Volts, and 30 Amps, minimum.
- B. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive 2-color bodies, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every 2 instrument cables terminated. Grounding terminal blocks shall be U.L. rated for 600 Volts, and 20 Amps, minimum.
- C. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.
- D. DIN mount fuse holders shall have blown fuse indicators for EC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be U.L. listed, and rated for 600 Volts. Fuse sizes shall not exceed the U.L. current rating for the fuse holders.
- E. DIN rail shall be prepunched, zinc bichromate plated steel. Symmetrical DIN rail shall be 35 mmX7.5mm, minimum.

- F. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.

2.2 SURGE PROTECTION BLOCKS (SPB):

- A. Analog inputs and outputs shall be terminated at surge protection blocks (SPB). He SPBs shall be designed for a working voltage of 32 volts, and shall be fused.
- B. SPBs shall provide full hybrid line to line protection, and shall have a GDT rating of 10,000 A (8/20us pulse waveform).
- C. SPBs shall be UL94 V-2 listed.

2.3 POWER DISTRIBUTION BLOCKS (PDB):

- A. PDBs shall be Electro-tin plated and manufactured from high strength 6061-T6 aluminum alloy.
- B. PDBs shall be UL Recognized rated 90° and CSA Certified.
- C. PDBs shall provide flexibility in using the connector as an in line splice or to reduce conductor size.
- D. PDBs shall be rated for 600 Volts and dual rated for Copper and Aluminum Conductor.
- E. PDBs shall have the sizes and ratings per NEC.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Each terminal block and fuse holder shall be identified with the circuit number, or conductor number, corresponding to the identification appearing on the shop Drawings for the equipment, or system.
- B. Terminal block and fuse holder markers shall be computer printed plastic-type, with permanent markings.
- C. End clamps and end sections shall be installed on each terminal block and fuse holder assembly.
- D. Terminal blocks for DC voltages shall be blue, and AC voltages shall be gray.

END OF SECTION

SECTION 26 28 13

FUSES

PART 1 - GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
- B. Fuses.
- C. Spare Fuse Cabinet.

1.2 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications including but not limited to the following:
 - 1. Section 26 05 00 - Electrical General Requirements
 - 2. Section 26 05 19 – Conductors and Cables

1.3 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Bussmann.
- B. Other acceptable manufacturers: Gould Shawmut, Little Fuse.
- C. All fuses shall be of one manufacturer. Fuses shall have a 200,000 ampere RMS symmetrical interrupting rating unless noted otherwise.

PART 2 - PRODUCTS

2.1 FUSE TYPES AND RATINGS

- A. Fuses from 0 to 600 ampere for each circuit serving a single motor shall be UL Class RK5 dual-element Low Peak, LPN-RK (250 volt), LPS-RK (600 Volt).
- B. All other fuses in the 0 to 600 ampere range shall be UL Class RK5, dual-element, time delay, low peak, LPN-RK (250 volt), LPS-RK (600 Volt).
- C. Fuses larger than 600 ampere shall be UL Class L with time delay, Hi Cap, KRP-C.
- D. High voltage fuses - see drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Motor circuits shall be fused. Fuses, 0 to 600 amperes, for 1.15 service factor motors shall be sized not exceeding 125% of motor full load amperes shown on nameplate. Fuses, 0 to 600 amperes, for all other motors shall be sized not exceeding 115% of motor full load amperes. Fuses above 600 amperes for all motors shall be sized up to 150% of motor full load amperes. Abnormal motor starting conditions requiring over sizing shall be coordinated with motor manufacturer.
- B. Spare fuses shall be furnished for all fuse types. Spares shall amount to 10% of installed fuses with a minimum of one set of each fuse type and ampere rating. The set shall equal the number of poles in the appropriate switch.
- C. Provide Spare Fuse Cabinet equal to Bussmann for storing spare fuses. Mount on wall in Equipment Room as directed by the ENGINEER.

END OF SECTION

SECTION 26 28 19
DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To
 - 1. Furnish and install disconnects as described in Contract Documents, except those provided integral with equipment.
- B. Related Sections
 - 1. Section 26 05 00 - Electrical General Requirements
 - 2. Section 26 05 09 - Electrical Identification
 - 3. Section 26 28 13 – Fuses

1.2 SUBMITTALS

- A. Submit product literature including manufacturer part number, model number, material, size, ratings, and specifications.
- B. Refer to Section 26 05 00 for submittal requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturer
 - 1. 1. Same MANUFACTURER as Panels.
- B. Disconnect Switches:
 - 1. Heavy duty quick-make, quick-break type, fused, unless indicated otherwise. Provide a control switch for VFD fed motors which will disengage the VFD prior to opening the switch.
 - 2. Provide interlock to prevent opening of door when switch is in ON position.
 - 3. Provide means to lock switch in OFF position with padlock.
 - 4. Disconnects for motor circuits shall be horsepower rated.
 - 5. Where indicated on Drawings for small motors, disconnects shall be manual starter with thermal overload relay.

- a. Device shall have one pole per ungrounded conductor of motor.
 - b. Provide overload relay to match motor full load amps.
 - c. Equip with lockout device.
6. Enclosures:
- a. Interior Dry locations - NEMA Type 12, or as indicated or required.
 - b. Exterior, Damp, or Wet Locations - NEMA Type 4X Stainless steel, or as indicated or required.
7. Fuses:
- a. Fuse fused disconnects with dual-element time delay fuses and equip with rejection type fuse holders.
 - b. Fuses on shall be from single manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Label disconnects to indicate equipment served, such as Condensing Unit CU-1. Use 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letter shall be 1/4 (6 mm) inch high. Attach labels with screws.

END OF SECTION

SECTION 26 35 53 SURGE PROTECTION DEVICES

PART 1 – GENERAL

1.01 SCOPE

The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

1. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.
2. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
3. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.03 REFERENCES

1. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards
 - A. ANSI/UL 1449 4th Edition or later
 - B. ANSI/UL 1283 5th Edition or later (type 2 applications)
 - C. IEEE C62.41.1
 - D. IEEE C62.41.2
 - E. IEEE C62.43-2005
 - F. IEEE C62.45-2002
 - G. IEEE C62.48-2005
 - H. IEEE C62.62-2010
 - I. UL 96A
 - J. NFPA 780

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

2. The following information shall be submitted to the Engineer:
 - A. Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website www.ul.org, the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (In).
3. Where applicable the following additional information shall be submitted to the engineer:
 - A. Descriptive bulletins
 - B. Product sheets

1.05 SUBMITTALS – FOR CONSTRUCTION

4. The following information shall be submitted for record purposes:
 - A. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process

2.08 QUALIFICATIONS

5. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the electrical distribution equipment.
6. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.
7. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
8. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.
9. The SPD shall be UL 1449 current edition listed, 20 kA nominal discharge current, Type 1 or Type 2 for use in UL 96A systems.

1.06 DELIVERY, STORAGE AND HANDLING

Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.07 OPERATION AND MAINTENANCE MANUALS

Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 – GENERAL

2.01 MANUFACTURERS

- 1. Eaton or prior approved equal.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

- 1. Electrical Requirements

- A. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
- B. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
- C. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
- D. Unit shall operate without the need for an external overcurrent protection device, and be listed by UL as such. Unit must not require external overcurrent protective device or replaceable internal overcurrent protective devices for the UL Listing.
- E. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection Modes			
	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A

Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

- F. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
- G. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

2. SPD Design

- A. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- B. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
- C. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
 - a. Type 2 units with filtering shall conform to UL 1283 5th Edition
 - b. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.
- D. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.

- E. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
- a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
 - ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes
 - iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - b. Remote Status Monitor (optional) – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
 - c. Audible Alarm and Silence Button (optional) – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
 - d. Surge Counter (optional) – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
 - i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

F. Thermal MOV Protection

The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

Fully Integrated Component Design – All of the SPD’s components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

G. Safety Requirements

The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

- a. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.03 SYSTEM APPLICATION

- 1. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- 2. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

1. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

- A. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
- B. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
- C. The panelboard shall be capable of re-energizing upon removal of the SPD.
- D. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes if a disconnect is required.
- E. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
- F. The SPD shall be of the same manufacturer as the panelboard.
- G. The complete panelboard including the SPD shall be UL67 listed.

2.05 SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS

- A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
- B. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, or busway

- C. The SPD shall be factory installed integral to the switchgear, switchboard, MCC, and/or bus plug at the assembly plant by the original equipment manufacturer
- D. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- E. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
- F. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
- G. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.06 SERVICE ENTRANCE REQUIREMENTS

- A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments. EXECUTION.

2.07 EXAMINATION

2.08 FACTORY TESTING

- 1. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

2.09 INSTALLATION

- 1. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes and the contract drawings.

2.10 WARRANTY

- 1. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.

END OF SECTION

**SECTION 26 41 00
LIGHTNING PROTECTION**

PART 1 - GENERAL

1.1 SCOPE

Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

- A. Air terminals and interconnecting conductors.
- B. Grounding and bonding for lightning protection.

1.2 APPLICABLE SECTIONS

The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;

- A. Section 26 05 00 - Electrical General Requirements.
- B. Section 26 05 19 - Conductors and Cables.

1.3 REFERENCES

- A. LPI-175 - Lightning Protection Installation Standard.
- B. LPI-176 - Lightning Protection System Material and Components Standard.
- C. LPI-177 - Inspection Guide for LPI Certified Systems.
- D. NFPA 78 - Lightning Protection Code.
- E. UL 96 - Lightning Protection Components.
- F. UL 96A - Installation Requirements for Lightning Protection Systems.

1.4 SYSTEM DESCRIPTION

- A. Lightning Protection System: Conductor system protecting consisting of air terminals on roofs, roof-mounted mechanical equipment, chimneys and stacks, parapets, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors.

1.5 SUBMITTALS FOR REVIEW

- A. Section 26 05 00 – Electrical General Requirements: Procedures for submittals.
- B. Shop Drawings: Indicate layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.

- C. Product Data: Provide dimensions and materials of each component, and include indication of listing in accordance with UL 96.

1.6 PROJECT CLOSEOUT SUBMITTALS

- A. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 70.
- B. Perform Work in accordance with UL 96A
- C. Perform Work in accordance with LPI-175

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in lightning protection equipment with minimum three years experience and member of the Lightning Protection Institute.
- B. Installer: Authorized installer of manufacturer with minimum three years experience and certified by the Lightning Protection Institute.

1.9 REGULATORY REQUIREMENTS

- A. Product Listing: UL 96 and LPI-176.
- B. System shall be UL listed and certified.

1.10 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

1.11 COORDINATION

- A. Coordinate work with roofing and exterior and interior finish installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND INSTALLERS

- A. VFC Corporation. North Salt Lake, Utah.
- B. Robbins Lightning, Inc.

2.2 COMPONENTS

- A. Air Terminals: Copper solid with adhesive bases for single-ply roof installations.
- B. Air Terminal for Chimney: Lead-coated copper.
- C. Grounding Rods: Solid copper

- D. Ground Plate: Copper.
- E. Conductors: Copper cable
- F. Connectors and Splices: Bronze

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 78, UL 96A and LPI-175.
- B. Connect conductors using exothermic welding process. Protect adjacent construction elements and finishes from damage. All welds shall be witnessed by the OWNER.
- C. Bond exterior metal bodies on building to lightning protection system and provide intermediate level interconnection loops 60 feet (18 m) on center.

3.2 FIELD QUALITY CONTROL

- A. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and labeling of the lightning protection system in accordance with UL 96A.
- B. Obtain the services of the Lightning Protection Institute to provide inspection and certification of lightning protection system in accordance with LPI-177.

END OF SECTION

SECTION 26 51 13
INTERIOR LUMINAIRES

PART 1 - GENERAL

1.01 SCOPE

- A. Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
 - 1. Interior luminaires and accessories.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Ballasts.
 - 5. Fluorescent lamp emergency power supply.
 - 6. Lamps.
 - 7. Luminaire accessories.

1.02 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;
- B. Section 260500- Electrical General Requirements.

1.03 REFERENCES

- A. ANSI C78.379 - Electric Lamps - Incandescent and Issued October 1993 High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps -Specifications.
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
- D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 101 - Life Safety Code.

1.04 SUBMITTALS FOR REVIEW

- A. Section 260500 - Electrical General Requirements
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.05 SUBMITTALS FOR CLOSEOUT

- A. Section 260500 - Electrical General Requirements
- B. Submit manufacturer's operation and maintenance instructions for each product.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 101.
- C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.08 EXTRA PRODUCTS

- A. Section 260500 - Contract Closeout.
- B. Furnish 10% or a minimum of two of each lens type.
- C. Furnish one case of replacement fluorescent lamps for each lamp type. Furnish two replacement lamps for each size HID lamp type and LED assembly.
- D. Furnish 10% or a minimum of two of each ballast type or driver type.

PART 2 - PRODUCTS

2.01 LUMINAIRES

- A. Furnish Products as scheduled. Refer to Section 260500 for substitutions and product options.
- B. Lighting Fixtures: Shall be as shown in the Lighting Fixture Schedule on the Drawings.

2.04 LED LUMINAIRE WARRANTY

- A. Provide a written 5-year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.
 - 1. Include finish warranty to include failure and substantial deterioration

such as blistering, cracking, peeling, chalking, or fading.

2. Material warranty must include:
 - a. All drivers.
 - b. Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.
- B. Warranty period must begin on date of beneficial occupancy. Provide the Contracting Officer with signed warranty certificates prior to final payment.

2.05 PROVIDE LUMINAIRE USEFUL LIFE CERTIFICATE

Submit certification from the manufacturer indicating the expected useful life of the luminaires provided. The useful life must be directly correlated from the IES LM-80 test data using procedures outlined in IES TM-21. Thermal properties of the specific luminaire and local ambient operating temperature and conditions must be taken into consideration.

2.06 LUMINAIRES

UL 1598, NEMA C82.77, and UL 8750. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. Provide all luminaires of the same type by the same manufacturer. Luminaires must be specifically designed for use with the driver, ballast or generator and light source provided.

2.07 LED LUMINAIRES

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires.

LED luminaires must meet the minimum requirements in the following table:

LUMINAIRE TYPE	MINIMUM LUMINAIRE EFFICACY (LE)	MINIMUM COLOR RENDERING INDEX (CRI)
LED TROFFER – 1 x 4300 x 1200 2 x 2600 x 600 2 x 4600 x 1200	90 LPW	80
LED Downlight	50 LPW	90
LED Track or Accent	40 LPW	80
LED Low Bay/High Bay	80 LPW	70
LED Linear Ambient	80 LPW	80

LED luminaires must also meet the following minimum requirements:

- A. Luminaires must have a minimum 5-year manufacturer's warranty.
- B. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES TM-21, with data obtained per IES LM-80 requirements.
- C. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
- D. Luminaires must be tested to IES LM-79 and IES LM-80 standards, with the results provided as required in the Submittals paragraph of this specification.

2.08 FLUORESCENT LUMINAIRES

Fluorescent luminaires are not acceptable.

2.09 HIGH INTENSITY DISCHARGE (HID) LUMINAIRES

HID Luminaires are not acceptable.

2.10 LUMINAIRES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide LED luminaires for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

2.11 LED DRIVERS

NEMA SSL 1, UL 8750. LED drivers must be electronic, UL Class 1, constant-current type and comply with the following requirements:

- A. Output power (watts) and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.
- B. Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.
- C. Current draw Total Harmonic Distortion (THD) of less than 20 percent.

- D. Class A sound rating.
- E. Operable at input voltage of 120-277 volts at 60 hertz.
- F. Minimum 5-year manufacturer's warranty.
- G. RoHS compliant.
- H. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.
- I. UL listed for dry or damp locations typical of interior installations.
- J. Non-dimmable, or fully-dimmable to 1% using 0-10V, or 3 wire, control as indicated in luminaire schedule and on drawings.

2.16 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type and wattage as indicated in luminaire schedule on project plans.

- A. LED Light Sources
 - 1. Correlated Color Temperature (CCT) between 3000 and 5000 degrees K as indicated.
 - 2. Minimum Color Rendering Index (CRI) R9 value of 80.
 - 3. High power, white light output utilizing phosphor conversion (PC) process or mixed system of colored LEDs, typically red, green and blue (RGB).
 - 4. RoHS compliant.
 - 5. Provide light source color consistency by utilizing a binning tolerance within a 3 step McAdam ellipse.

2.17 CONTROLS

- A. Dual Technology Wall Mounted Occupancy Sensors: Spaces indicated on drawings shall be equipped with a dual technology occupancy sensor DT-100L as manufacturer by Wattstopper or equal. The sensors shall be connected to a power supply as specified above. The sensor shall comply with the following specifications:
 - 1. Shall utilize PIR and Ultrasonic technologies with an adjustable integrated light level sensor for 2.5 to 430 foot-candles. The output shall be a single-pole, double-throw isolated relay.
 - 2. Shall utilize 40Khz +/- .006% ultrasonic frequency.
 - 3. Shall provide an adjustable time delay of 15 seconds to 15 minutes and an LED indicator for both technologies.
 - 4. Shall provide adjustable sensitivities, and shall be capable of installing two units per power pack.

5. Shall be UL listed with a 5 year warranty.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- B. Support luminaires independent of ceiling grid, if lay-in type ceilings or concealed spline ceilings are used.
- C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

3.02 INSTALLATION OF LIGHTING FIXTURES

- A. Install all lighting fixtures complete and ready for service, in accordance with the Fixture Schedule on the Drawings:
- B. Wire all fixtures with fixture wiring of at least 150 degree C rating. Conductors in wiring channels of fixtures mounted in rows shall be the same size as the circuit wiring supplying the rows.
- C. Install all fixtures straight and true with reference to adjacent walls.
- D. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building, using adequate number and type of fasteners to ensure a safe installation. Screwed fastenings and toggles through ceiling or wall material are not acceptable. Provide suitable connectors or collars to connect adjoining fixtures in continuous rows.
- E. Do not support fixtures from roof deck. Provide unistrut channels spanning space between roof joists to support fixtures and outlets.
- F. Fixtures mounted in lay-in grid ceilings shall have safety support wires to structural roof members as detailed for seismic restraint.
- G. All single outlets shall be properly centered in each room. Where two or more outlets occur, they shall be spaced uniformly and in straight lines with each other.
- H. Provide plaster frames and support channels around ceiling openings for recessed fixtures. Securely fasten to ceiling structural members.
- I. Terminate circuits for recessed fixtures in an extension outlet box adjacent to ceiling

opening and connect to fixtures with flexible steel conduit.

3.03 Where lighting fixtures and other electrical items are shown in conflict with locations and structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.

3.04 ADJUSTING

A. Section 260500 Contract Closeout

3.05 CLEANING

- A. Section 260500 - Contract Closeout: Cleaning installed work.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.06 DEMONSTRATION AND INSTRUCTIONS

- A. Section 260500 - Contract Closeout - Starting of Systems: Demonstrating installed work.
- B. Demonstrate luminaire operation for 12 hours.

3.07 PROTECTION OF FINISHED WORK

- A. Re-lamp or repair/replace luminaires that have failed at substantial completion.

END OF SECTION

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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. Section 31 23 33 – Trenching and Backfilling for Pipelines and Utilities.
3. Section 31 11 23 – Aggregate Base Course.
4. American Public Works Association (APWA) Specifications (latest version)

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/foot³ (2,700 kN-m/m³))
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:

Relatively well graded sandy gravel, with a maximum Plasticity Index of 6. 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
4-inch	100
¾-inch	Minimum 70
No. 200	Maximum 20

Place below structures, foundations, shallow footings, flatwork, pavement, and as shown on the Drawings.

- B. Type M2, Granular Backfill:

Imported granular backfill is required to establish final grade throughout the site. Granular soil, with a maximum Plasticity Index of 6. 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
¾-inch	Minimum 70
No. 200	Maximum 20

Place over larger areas to raise the site grade and as shown on the Drawings.

- C. Type M3, Free Draining Gravel:

In order to facilitate curing of the concrete, floor slabs shall be directly underlain by at least 4 inches of “free-draining” fill, such as pea gravel or ¾-inch to 1-inch minus clean, gap-graded gravel. 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

Placed under concrete floor slabs as free draining gravel.

D. Type M4, Non-Structural Fill:

On-site soils or imported soils, with a maximum particle size of 8-inches, including silt/clay soils not containing excessive amounts of degradable/organic material. The fill shall be compacted to an in-place density equal to at least 90 percent of the maximum density as determined by ASTM D1557.

Sieve Size	Percent Passing
8-inch	100

Placed below non-structural areas, such as landscaping.

E. Type M5, Stabilization Fill:

Coarse angular gravels and cobbles 1-inch to 8-inches in size.

May also use 1.5 to 2.0-inch gravel placed on stabilization fabric, such as Mirafi Rs280i or equivalent.

Size	Percent Passing
8-inch	100
1-inch	0

Placed to stabilize soft areas prior to placing structural fill and/or grading fill.

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 M6, Aggregate Base Course (Road Base): Free of shale, clay, friable material and debris; Meet Utah Department of Transportation (UDOT) Aggregate Base Course, Standard Specification Section 02721:

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 19.13
GEOTEXTILE LINER**

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Geotextiles

1.2 RELATED SECTIONS

A. Section 31 05 19.16 Geomembrane Liner

1.3 REFERENCES

A. ASTM International:

1. ASTM D 5261, Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
2. ASTM D 4355, Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus).
3. ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
4. ASTM D 4533, Standard Test Method for Index Trapezoidal Tearing Strength of Geotextiles.
5. ASTM D 4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
6. ASTM D 4873, Guide for Identification, Storage and Handling of Geotextiles.
7. ASTM D 4491, Standard Test Method for Water Permeability of Geotextiles by Permittivity.
8. ASTM D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
9. ASTM D 4354, Standard Practice for Sampling of Geosynthetics for Testing.
10. ASTM D 4759, Standard Practice for Determining the Specifications Conformance of Geosynthetics.

B. GRI Standards

1. GT 12(a) Test Methods and Properties for Nonwoven Geotextiles Used as Protection (or Cushioning) Materials

1.4 LINER DESIGN AND PERFORMANCE REQUIREMENTS

- A. Compatibility with project site and stored water.
 1. Project site located near Mount Pleasant City, UT.
 2. The ponds are intended to store treated municipal effluent from existing wastewater treatment lagoons.
 3. Water quality: Typical of treated municipal lagoon effluent.
- B. Operating air temperature range: -40°F to 110°F.
- C. Durable, long-lasting, weather resistant with 20-year design life.
- D. Meet or exceed requirements of these specifications in order to meet design and performance requirements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 33 00. Document compliance with 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. Submit Daily Field Reports: Include results of inspections, subgrade acceptability, quality control program, liner slack information, and field tests for compliance or non-compliance with specified requirements.
- E. Name and credentials of independent laboratory that will provide verification testing on destructive samples.
- F. Certification that geotextile has been installed in accordance with the Contract Documents.
- G. Material and installation warranties.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 33 00.
- B. Record actual locations of field seams, samples, repairs, tests, air/gas vents, and ladders.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 78 23.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing of geotextile liner material with minimum five (5) years documented experience and having manufactured a minimum of 5,000,000 square feet of geotextile in the last year.
- B. Fabricator or Installer:
 - 1. Company specializing in installation of Geomembrane liners with a minimum of five (5) years' documented experience and at least 10,000,000 square feet of installed liner.
 - 2. Installer shall be approved by the manufacturer for installation of their product.
 - 3. The installation supervisor shall have worked in a similar capacity on at least four projects of similar scope.
 - 4. The installer shall provide at least one master seamer on the project who has completed a minimum of 1,000,000 square feet of geomembrane seaming work using the same type of welding apparatus proposed for use on this project.

1.9 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle liner at site in accordance with manufacturer's guidelines and recommendations and Section 01 12 16.
- B. Coordinate delivery of liner sheets to project site with Owner.
- C. Inspect shipment with Engineer and Owner.
- D. Store geotextile and protect from punctures, abrasions, and excessive dirt and moisture in the areas indicated on the plans. Storage areas shall be level (no pallets or block-style supports), smooth, and dry.
- E. Labeling: Each roll of geotextile liner delivered to the site shall have a manufacturer's label identifying:
 - 1. Manufacturer's name.

2. Product identification.
3. Thickness.
4. Length.
5. Width.
6. Roll number.

1.10 SEQUENCING AND SCHEDULING

- A. Sequence and schedule work under provisions of Section 01 12 16.
- B. Manufacture, deliver, and unload liner sheet for storage at the site until installed.
- C. Coordinate installation of liner with earthwork activities.
- D. Provide at least five (5) days advance notice to Engineer prior to beginning any major work activities for coordination of construction observation.

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. The geomembrane shall conform to the test property requirements prescribed in the table included in Appendix A at the end of this section titled "Table 31 05 19.13-1" for 12 oz/yd².
 1. The values listed in Table 31 05 19.13-1 of this specification are to be interpreted according to the designated test method.
 2. Sampling shall be in accordance with specific test methods listed in Table 31 05 19.13-1. If no sampling protocol is stipulated, test specimens shall be taken along evenly spaced intervals across the entire roll width.
 3. The number of tests shall be in accordance with the appropriate test methods listed in Table 31 05 19.13-1.
 4. Minimum Average Roll Value (MARV) – For geosynthetics, a manufacturing quality control tool used to allow manufacturers to establish published values such that the user/purchaser will have a 97.7% confidence that the property in question will meet published values. For normally distributed data, "MARV" is calculated as the

typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated

5. With one specific property. If the results of any tests do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.
- 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.

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.
- D. Sequence work and have necessary equipment and materials on hand to prevent damage to partially complete liner installation and lagoon surface by weather conditions, including wind, precipitation, and high and low temperatures.

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. 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.

3.5 QUALITY ASSURANCE

- A. Geotextiles shall be subject to sampling and testing to verify conformance with this specification.
- B. All sampling and testing shall be at the expense of the Contractor. Independent third-party testing shall be performed by a Geosynthetics Accreditation Institute (GAI) accredited testing laboratory.

- C. Submit reports and test results to Engineer by the independent testing laboratory and for field testing, indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.
- D. Report immediately all failing tests to Engineer. Areas of repeated testing failure may require removal and replacement of material at no cost to Owner.
- E. The frequency of testing may be increased by the Engineer when repeated failed tests have been recorded. Contractor shall be responsible for all costs of added frequency for material testing.
- F. Repair and test all holes in the geotextile resulting from destructive sampling in accordance with these specifications.
- G. If the results of any test do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer's quality manual.

3.6 WARRANTY

A. Installer's Warranty

- 1. The installer shall warrant to the Owner and shall provide to the Owner an executed warranty at the completion of the terms of the contract that the geotextile is free from installation defects as defined by these specifications and is able to withstand normal weathering and operating conditions for a period of one (1) year from the date the warranty is executed.

B. Manufacturer's Warranty:

- 1. The manufacturer shall warrant to the Owner and shall provide to the Owner an executed warranty at the completion of the terms of the contract that each geotextile is free from manufacturing defects, as defined by these specifications and is able to withstand deterioration due to the effects of ozone, ultraviolet or other normal weathering on a pro-rata basis for a period of twenty (20) years from the date the warranty is executed.

APPENDIX A: TABLE 31 05 19.13-1 - Non-Woven Geotextile Fabric

Property ⁽¹⁾	Test Method ASTM	Unit	Mass/Unit Area (oz/yd ²)					
			10	12	16	24	32	60
Mass per unit area	D5261	oz/yd ²	10	12	16	24	32	60
Grab tensile strength	D4632	lb	230	300	370	450	500	630
Grab tensile elongation	D4632	%	50	50	50	50	50	50
Trap. Tear strength	D4533	lb	95	115	145	200	215	290
Puncture (CBR) strength	D6241	lb	700	800	900	1100	1700	2400
UV resistance ⁽²⁾	D7238	%	70	70	70	70	70	70

(1) All values are MARV except UV resistance; it is a minimum value.

(2) Evaluation to be on 2.0 inch strip tensile specimens per ASTM D 5035 after 500 lt. hrs. exposure.

(App. A Tables from Geosynthetic Research Institute)

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**SECTION 31 05 19.16
GEOMEMBRANE LINER**

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Design, manufacturing, supply, installation, and testing of geomembrane liner.

1.2 REFERENCES

A. ASTM International:

1. ASTM D1238 - Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
2. ASTM D1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
3. ASTM D1603 - Test Method for Carbon Black in Olefin Plastics.
4. ASTM D792 - Specific Gravity (Relative Density) and Density of Plastics by Displacement.
5. ASTM D1505 - Test Method for Density of Plastics by the Density-Gradient Technique.
6. ASTM D3895 - Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
7. ASTM D4218 - Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
8. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
9. ASTM D5199 - Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
10. ASTM D5397 - Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix.
11. ASTM D5596 - Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
12. ASTM D5641 – Geomembrane Seam Evaluation by Vacuum Chamber.

13. ASTM D5721 - Practice for Air-Oven Aging of Polyolefin Geomembranes.
14. ASTM D5820 – Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
15. ASTM D5885 - Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
16. ASTM D6392 - Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
17. ASTM D7240 – Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique.
18. ASTM D751 - Standard Test Methods for Coated Fabrics.

B. EPA Standards

1. EPA 600/2.88/052 (NTIS PB-89-129670) of Waste Containment and Other Containment Facilities
2. U.S. Environmental Protection Agency Technical Guidance Document “Quality Control Assurance and Quality Control for Waste Containment Facilities,” EPA/600/R-93/182, September 1993, 305 pgs.

C. NSF Standards

1. NSF International Standard, Flexible Membrane Liners, NSF 54-1993 (depreciated)

D. GRI Standards

1. GM 10 - Specification for the Stress Crack Resistance of Geomembrane Sheet
2. GM 11 - Accelerated Weathering of Geomembranes Using a Fluorescent UVA-Condensation Exposure Device
3. GM 13 - Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
4. GM 14 - Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes

1.3 LINER DESIGN AND PERFORMANCE REQUIREMENTS

A. Compatibility with project site and stored water.

1. Project site located near Mount Pleasant City, UT.

2. The ponds are intended to store treated municipal effluent from existing wastewater treatment lagoons.
 3. Water quality: Typical of treated municipal lagoon effluent.
- B. Operating air temperature range: -40°F to 110°F.
 - C. Durable, long-lasting, weather resistant with 20-year design life.
 - D. Meet or exceed requirements of these specifications in order to meet design and performance requirements.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00. Document compliance with specifications. Indicate products are suitable for application.
- B. Shop Drawings:
 1. Submit proposed lining sheet layout with proposed size, number, position and sequence of placing of all sheets. Horizontal seams on slopes greater than 10% will not be allowed. Field changes to layout will require Engineer approval. Lining sheet layout must be approved prior to installation.
 2. Show location, direction, and type of all field joints.
 3. Show details and methods for anchoring the liner, making of field joints, seals at structures, air/gas vent configuration, safety ladders, repair of locations where samples are taken, ballast tubes, and liner penetrations.
- C. Resin Data: Prior to shipment of liner, provide resin data including physical properties specified and certification stating that the resin meets the specification requirements.
- D. Certification that no post-consumer resin of any type has been added to the formulation and that the resin contains no more than 10% rework of similar geomembrane parent material. Recycled product run is acceptable.
- E. Prior to shipment of liner, provide test data for the geomembrane liner to document compliance with the technical specifications.
- F. Manufacturer's Quality Assurance/Quality Control Program.
- G. Samples: Submit two (2) typical samples of the geomembrane liner with each type of seam to be provided.
- H. Documentation of installer's qualifications as specified.

- I. Geosynthetic Field Installation Quality Assurance Plan.
- J. Liner slack:
 - 1. Contractor shall submit documentation identifying the coefficient of thermal expansion for the supplied liner material.
 - 2. Contractor shall record on the panel layout and daily field reports the ambient temperature of the liner at the time of welding and the length of slack incorporated at the toe at that time.
 - 3. Sufficient slack shall be incorporated into the installation to prevent bridging under anticipated operating temperatures specified.
- K. Submit Daily Field Reports: Include results of inspections, subgrade acceptability, quality control program, liner slack information, and field tests for compliance or non-compliance with specified requirements.
- L. Name and credentials of independent laboratory that will provide verification testing on destructive samples.
- M. Certification that geomembrane has been installed in accordance with the Contract Documents.
- N. Material and installation warranties.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 33 00.
- B. Record actual locations of field seams, samples, repairs, tests, air/gas vents, and ladders.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 78 23.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing of HDPE liner material with minimum five (5) years documented experience and having manufactured a minimum of 5,000,000 square feet of geomembrane in the last year.
- B. Fabricator or Installer:

1. Company specializing in installation of HDPE liners with a minimum of five (5) years' documented experience and at least 10,000,000 square feet of installed liner.
2. Installer shall be approved by the manufacturer for installation of their product.
3. The installation supervisor shall have worked in a similar capacity on at least four projects of similar scope.
4. The installer shall provide at least one master seamer on the project who has completed a minimum of 1,000,000 square feet of geomembrane seaming work using the same type of welding apparatus proposed for use on this project.
5. Engineer Approved Equal:
 - a. Northwest Linings and Geotextile Products, Inc.
 - i. Representative:

Rick Newton
Phone: (253) 872-0244
Email: rickn@northwestlinings.com
 - b. Industrial and Environmental Concepts, Inc.
 - i. Representative:

Michael Moe
Phone: (801) 842-7702
Email: mmoe@miscowater.com
 - c. Colorado Lining International, Inc.
 - i. Representative:

Alan Strecker
Phone: (720) 737-8778
Email: alan.strecker@viaflex.com

1.8 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle liner at site in accordance with manufacturer's guidelines and recommendations and Section 01 12 16.
- B. Coordinate delivery of liner sheets to project site with Owner.
- C. Inspect shipment with Engineer and Owner.
- D. Liner materials shall be delivered to the site in rolls covered in a watertight wrapping. If liner is delivered without an adequate protective wrapping, the outer wrap and any

damaged liner of roll will be removed and discarded, based on a visual inspection of entire roll, prior to installation of liner. The geomembrane shall be rolled onto a substantial core or core segments and held firm by straps/slings or other means.

- E. Provide equipment and personnel to unload liner and place liner on the site in an acceptable position for storage pending installation.
- F. Support bars and straps designed to protect the liner from damage shall be utilized in the handling and transportation of the rolls of liner on the site. Transportation of the liner with loader buckets or other methods, which place the liner in direct contact with metal or other surfaces that could damage the liner, are unacceptable.
- G. Store geomembrane and protect from punctures, abrasions, and excessive dirt and moisture in the areas indicated on the plans. Storage areas shall be level (no pallets or block-style supports), smooth, and dry.
- H. Labeling: Each roll of geomembrane liner delivered to the site shall have a manufacturer's label identifying:
 - 1. Manufacturer's name.
 - 2. Product identification.
 - 3. Thickness.
 - 4. Length.
 - 5. Width.
 - 6. Roll number.

1.9 SEQUENCING AND SCHEDULING

- A. Sequence and schedule work under provisions of Section 01 12 16.
- B. Manufacture, deliver, and unload liner sheet for storage at the site until installed.
- C. Coordinate installation of liner with earthwork activities.
- D. Provide at least five (5) days advance notice to Engineer prior to beginning any major work activities for coordination of construction observation.
- E. Coordinate with Owner regarding Owner-provided leakage test and any necessary repairs after pond is filled and tested.

PART 2. PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE (HDPE) LINER

- A. New first quality product designed and manufactured specifically for the purpose of this Work.
- B. Resin: New, first quality, compounded and manufactured specifically for producing geomembranes. Natural resin (without carbon black) shall meet the following requirements:

Property	Test Method	Units	Required
Density	ASTM D1505	g/cm ³	≥0.932
Melt Flow Index	ASTM D1238	g/10 min	≤1.0
OIT	ASTM D3895 (1atm/200°C)	minutes	≥100

2.2 LINER SHEET:

- A. Smooth 60 mil HPDE liner.
- B. Durable, watertight, free of pinholes and contaminants.
- C. Will not degrade under operating conditions.
- D. Minimum width of sheet of twenty-two feet.
- E. The geomembrane shall conform to the test property requirements prescribed in the table included in Appendix A at the end of this section titled "Table 31 05 19.16-1" for 60 mils thickness.
 - 1. The values listed in Table 31 05 19.16-1 of this specification are to be interpreted according to the designated test method. The values provided are not to be interpreted as minimum average roll values or maximum average roll values.
 - 2. The HDPE geomembrane properties shall be tested at the minimum frequencies indicated in Table 31 05 19.16-1. If a specific manufacturer's quality control guide is more stringent, it should be followed.
 - 3. Sampling shall be in accordance with specific test methods listed in Table 31 05 19.16-1. If no sampling protocol is stipulated, test specimens shall be taken along evenly spaced intervals across the entire roll width.
 - 4. The number of tests shall be in accordance with the appropriate test methods listed in Table 31 05 19.16-1.

5. The average of the test results should be calculated per the particular standard cited and compared to the minimum value listed in Table 31 05 19.16-1, hence the values listed are the minimum average values and are designated as “min. ave”.
 6. If the results of any tests do not conform to the requirements of this specification, retesting to determine conformance or rejection should be done in accordance with the manufacturing protocol as set forth in the manufacturer’s quality manual.
- F. Do not exceed a combined maximum total of 1% by weight of additives other than carbon black.
 - G. Geomembrane shall be free of holes, bubbles, blisters, contamination by foreign matter, and nicks and cuts on roll edges.

2.3 CLEANING SOLVENT

- A. As recommended by manufacturer of the liner.

2.4 EXTRUDATE ROD OR BEAD

- A. High density polyethylene the same as the sheet resin with the same physical characteristics.
- B. Additives shall be thoroughly mixed.
- C. Materials shall be free of contamination by moisture of foreign matter.

2.5 CONNECTIONS

- A. Closed Cell Neoprene: Garlock rubber neoprene with a durometer of 40.
- B. Neoprene Contact Adhesive: As recommended by liner manufacturer for gluing closed cell neoprene to ductile iron, PVC and HDPE surfaces.
- C. Band Clamps: Stainless steel (304 SS) one-half (1/2) inch wide, 0.025 inch thick.
- D. Silicone Adhesive: Exterior grade per liner manufacturer’s recommendation for adhering geomembrane to PVC and cast iron.
- E. Embedment Strips: Per liner manufacturer’s recommendation with a minimum embedment depth in the concrete of 1 1/2 inches. Manufactured of HDPE material and leaving an exposed 3” minimum welding surface.
- F. Boot Sleeve: Same material as liner unless otherwise shown on Drawings.
- G. Safety Ladder Backing Sheet: Same material as liner with one side of the geomembrane sheet being textured unless otherwise shown on Drawings.

2.6 AIR/GAS VENTS

- A. As shown on Drawings.

PART 3. EXECUTION

3.1 PREPARATION

- A. Verify that the liner subgrade is to the indicated grades as in shown on the Drawings and is acceptable to receive the geomembrane liner.
- B. Provide daily written certifications that surface is acceptable for the liner. Placement of liner constitutes acceptance of the surface.
- C. Inspect stored liner sheets to verify that sheets have not been damaged in storage or handling.
- D. Schedule and coordinate liner activities with earthwork contractor, Owner and Engineer.
- E. Have on-site all equipment, personnel and supplies necessary to complete the installation of the liner in a workmanlike manner.
- F. Have on the job site accepted shop drawings, panel layout, geomembrane submittals, slack equations/tables, and Drawings and Specifications.
- G. Sequence work and have necessary equipment and materials on hand to prevent damage to partially complete liner installation and lagoon surface by weather conditions, including wind, precipitation, and high and low temperatures.

3.2 LINER SYSTEM SUBGRADE PREPARATION

- A. Rake all pond surfaces to be lined as necessary so the surface consists of fine granular materials and is smooth and free of sharp rocks and any debris that may affect the liners performance to a depth of three (3) inches.
- B. Proof roll the side slopes and pond bottom to create a smooth surface acceptable to the liner installer.
- C. Install a cushion layer of 6" of sand. Owner may choose to change cushion layer to 12 oz. geotextile as outlined in 01 22 00 Measurement and Payment.
- D. Coordinate preparation of surface with the liner installer. Contractor is responsible for preparing the surface to such a condition that willow the liner installer to certify to the acceptability of the subgrade for the liner system as required by this Section.

3.3 DEPLOYMENT

- A. Assign each panel a logical identifying code that matches the approved panel layout. Panels shall be labeled with grease pens during deployment.
- B. Use a sequential seam numbering system compatible with panel numbering system and consistent with the approved panel layout.
- C. To the maximum extent possible, orient seams parallel to line of slope.
- D. Minimize number of field seams in corners, odd shaped geometric locations and outside corners.
- E. Slope seams shall extend a minimum of five feet beyond the toe of slope onto the pond floor.
- F. Unroll geomembrane using methods that will not damage the geomembrane and will protect the underlying surface from damage.
- G. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it.
- H. Smoking will not be permitted on the geomembrane at any time during the project construction and testing.
- I. Limit vehicular traffic on the geomembrane to rubber tired vehicles with a ground pressure of less than 8 psi.
- J. Sufficient slack shall be provided in accordance with the field conditions and to prevent bridging or excessive wrinkles over the specified operating temperatures. Bridging or excessive wrinkles will be repaired by the Contractor at no cost to the Owner.

3.4 HDPE FIELD JOINTS

- A. Follow manufacturer's instructions.
- B. Overlap sheets a minimum of six (6) inches or as recommended by the manufacturer.
- C. Clean contact surface of all dirt, dust, moisture or other foreign materials.
- D. At least one master seamer as defined under the qualifications portion of this specification shall be provided by the installer to provide supervision over other welders.

- E. Extrusion welder and fusion welder equipment shall have gauges to monitor temperature in apparatus.
- F. Whenever possible, use the dual hot wedge process for making field joints; otherwise, use the extrusion welding process.
- G. Extrusion Welding:
 - 1. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.
 - 2. Prepare surface to be welded including abrasion and grinding in accordance with the manufacturer's recommendations.
 - 3. Purge welding apparatus of heat-degraded extrudate before welding.
 - 4. Apply sufficient molten extrudate along the seam to both contact surfaces to create a homogeneous weld.
 - 5. Maintain resin temperatures as it emerges from the die within 30°F of optimum temperature for extrusion welding.
- H. Dual Hot Wedge Welding:
 - 1. Welding equipment shall be self propelled and specifically manufactured to produce a double track seam.
 - 2. Clean seam area of dust, mud, moisture and debris immediately ahead of welder.
 - 3. Protect against moisture build-up between sheets.
 - 4. Monitor and maintain the temperature of the wedge within 30°F of optimum temperature for hot wedge welding.
- I. Trial Welds:
 - 1. Prior to making any production welds, trial welds are required to verify equipment and operator performance. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed the trial weld.
 - 2. Trial welds shall be completed under the same environmental conditions as production welds.

3. A minimum of two trial welds per day, per welding apparatus and welder, one made prior to the start of work, one at mid-shift, and anytime the welding apparatus is shut off for more than 30 minutes.
 4. Test welds are required each day that production welds are to be performed.
 5. Trial welds shall be destructively tested and field evaluated as specified in Part 3.4 of this section.
 6. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
- J. Seaming shall not proceed when ambient air temperature or adverse weather jeopardize the integrity of the seam. Installer shall comply with the requirements for adverse condition welding included in their Field Installation Quality Assurance Plan.

3.5 QUALITY ASSURANCE

- A. Visually inspect all seams and non-seam areas of the geomembrane for defect, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Repair all suspect locations.
- B. Test all double-wedge weld seams in HDPE liner with air pressure test in accordance with ASTM D5820.
- C. Test all extrusion welds in HDPE liner with a vacuum box in accordance with ASTM D5641. In lieu of vacuum testing all extrusion welds, spark testing in accordance with ASTM D7240 may be utilized. No additional payment will be made for spark testing extrusion welds and the cost of testing is considered incidental.
- D. When air pressure testing is used, pressurize channel between double heat wedge to 30 psi and hold for 5 minutes. Allow a pressure drop of no more than 2 psi in 5 minutes. Record test results along seams and in daily records.
- E. When vacuum testing seams, the vacuum box shall be kept stationary at each location for a period of no less than 10 seconds while maintaining a vacuum pressure of 4-8 psi and examining for holes in the seam.
- F. Perform destructive tests including tensile and peel tests on all field seams.
 1. A minimum of one test per 500 feet of seam length at a selected location acceptable to the Engineer.
 2. For each sample taken, the sample will be split into three parts. One sample will be used for an immediate field test, one sample shall be used for independent third-party testing, and one sample will be given to the Engineer.

- a. The Engineer’s sample shall be 12 inches by 12 inches.
 - b. The sample sizes for field testing shall be as necessary to provide a minimum of five test specimens in accordance with these specifications plus any samples to be retained by the Contractor or Installer.
 - c. The sample specimen to be sent to the independent third party testing laboratory shall be 12 inches by 18 inches.
3. Five individual test specimens shall be tested in accordance with ASTM D 6392 for both the field testing and independent third party testing. Results will be assessed based on the following table.

Double Wedge Welds	
Shear Strength ⁽¹⁾	120 lbs/in. min.
Shear Elongation at Break ⁽²⁾	50%
Peel Strength ⁽¹⁾	91 lbs/in. min.
Peel Separation	25% max.
Extrusion Fillet Weld	
Shear Strength ⁽¹⁾	120 lbs/in. min.
Shear Elongation at Break ⁽²⁾	50%
Peel Strength ⁽¹⁾	78 lbs/in. min.
Peel Separation	25% max.

⁽¹⁾ 4 out of 5 specimens must meet or exceed presented value, 5th specimen must meet or exceed 80% of presented value.
⁽²⁾ Elongation measurements are not required for field testing.

4. The following laws-of-break patterns as described by ASTM D 6392 are unacceptable:
- a. Double Wedge Welds: AD and AD-Brk>25%
 - b. Extrusion Fillet Welds: AD1, AD2 and AD-WLD (unless strength is achieved.)
- G. All sampling and testing shall be at the expense of the Contractor. Independent third-party testing shall be performed by a Geosynthetics Accreditation Institute (GAI) accredited testing laboratory.

- H. Submit reports and test results to Engineer by the independent testing laboratory and for field testing, indicating observations and results of tests and indicating compliance or noncompliance with Contract Documents.
- I. Report immediately all failing tests to Engineer. Areas of repeated testing failure may require removal and replacement of material at no cost to Owner.
- J. The frequency of testing may be increased by the Engineer when repeated failed tests have been recorded. Contractor shall be responsible for all costs of added frequency for material testing. GRI GM-14 will be used to establish any increase in testing frequency. However, the minimum testing frequency shall be as established in Paragraph 3.4.F.
- K. Repair and test all holes in the geomembrane resulting from destructive sampling in accordance with these specifications.
- L. If a seam fails any of the prescribed testing, follow one of two options:
 - 1. Reconstruct the seam between any two passed seam locations.
 - 2. Trace the weld to an intermediate location where passing results are achieved.
 - a. If tracing shows failed results to the end of a seam (within 10 feet), continue tracing on the next seam welded using the same device.
 - b. If any sample fails, the process shall be repeated to establish the zone in which the seam will be reconstructed.

3.6 REPAIR PROCEDURES

- A. Remove any damaged or unacceptable geomembrane and repair in accordance with these specifications.
- B. Repair any portion of geomembrane removed for destructive testing.
- C. Repair any portion of unsatisfactory seam area failing a destructive or non-destructive test.
- D. Contractor shall propose appropriate repair method to the Engineer for approval using one of the following repair methods:
 - 1. Patching. Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
 - 2. Abrading and re-welding. Used to repair short section of a seam.

3. Spot Welding. Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.
 4. Capping. Used to repair long lengths of failed seams.
 5. Remove the unacceptable seam and replace with new material.
- E. Non-destructively test all repair welds using methods specified.
- F. Number and log each patch repair and record on record drawings.

3.7 WARRANTY

A. Installer's Warranty

1. The installer shall warrant to the Owner and shall provide to the Owner an executed warranty at the completion of the terms of the contract that the geomembrane is free from installation defects as defined by these specifications and is able to withstand normal weathering and operating conditions for a period of one (1) year from the date the warranty is executed. Warranty shall be executed no earlier than the date with the installation passes the specified leakage test.

B. Manufacturer's Warranty:

1. The manufacturer shall warrant to the Owner and shall provide to the Owner an executed warranty at the completion of the terms of the contract that each geomembrane is free from manufacturing defects, as defined by these specifications and is able to withstand deterioration due to the effects of ozone, ultraviolet or other normal weathering on a pro-rata basis for a period of twenty (20) years from the date the warranty is executed. Warranty shall be executed no earlier than the date the installation passes the specified leakage test.

APPENDIX A: TABLE 31 05 19.16-1 - High Density Polyethylene (HDPE) Geomembrane - Smooth

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness (min. ave.)	D5199	Nom.	Nom.	Nom.	Nom.	Nom.	Nom.	Nom.	Per roll
• Lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density mg/l (min.)	D1505 / D792	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	0.940 g/cc	20,000 lb
Tensile Properties (1) (min. ave.)	D6693 Type IV	63 lb/in.	84 lb/in.	105 lb/in.	126 lb/in.	168 lb/in.	210 lb/in.	252 lb/in.	20,000 lb
• Yield strength		114 lb/in.	152 lb/in.	190 lb/in.	228 lb/in.	304 lb/in.	380 lb/in.	456 lb/in.	
• Break strength		12%	12%	12%	12%	12%	12%	12%	
• Yield elongation		700%	700%	700%	700%	700%	700%	700%	
• Break elongation									
Tear Resistance (min. ave.)	D1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D4833	54 lb	72 lb	90 lb	108 lb	144 lb	180 lb	216 lb	45,000 lb
Stress Crack Resistance (2)	D5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	Per GRI-GM10
Carbon Black Content (range)	D1603 (3)	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lb
Carbon Black Dispersion	D5596	Note (4)	Note (4)	Note (4)	Note (4)	Note (4)	Note (4)	Note (4)	45,000 lb
Oxidative Induction Time (OIT) (min. ave.) (5)									200,000 lb
(a) Standard OIT	D3895	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	100 min.	
—or—									
(b) High Pressure OIT	D5885	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	400 min.	
Oven Aging at 85°C (5), (6)	D5721								
(a) Standard OIT (min. ave.) - % retained after 90 days	D3895	55%	55%	55%	55%	55%	55%	55%	Per each formulation
—or—									
(b) High Pressure OIT (min. ave.) - % retained after 90 days	D5885	80%	80%	80%	80%	80%	80%	80%	
UV Resistance (7)	GM 11								
(a) Standard OIT (min. ave.)	D3895	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	N.R. (8)	Per each formulation
—or—									
(b) High Pressure OIT (min. ave.) - % retained after 1600 hrs (9)	D5885	50%	50%	50%	50%	50%	50%	50%	

- (1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
 Yield elongation is calculated using a gage length of 1.3 inches.
 Break elongation is calculated using a gage length of 2.0 inches.
- (2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- (3) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
- (4) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
 9 in Categories 1 or 2 and 1 in Category 3
- (5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- (6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.
- (7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
- (8) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.
- (9) UV resistance is based on percent retained value regardless of the original HP-OIT value.

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SECTION 31 10 00 SITE CLEARING

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface debris removal.
2. Stripping construction site of plant life and grass including root systems to a minimum six-inch depth.
3. Removal and disposal of shrubs and grasses.
4. Removing abandoned utilities.

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.
- 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 are 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. Topsoil 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. Section 31 23 33 – Trenching and Backfilling for Pipelines and Utilities.
3. American Public Works Association (APWA) Specifications (latest version).

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/foot³ (2,700 kN-m/m³)).
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 the name of the imported materials source. Provide materials from the same source throughout the course of the project.
- C. Manufacturer's Certificate: Certify Products that meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish each material from a single source throughout the Work.

PART 2. PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1: Excavated and reused material, see Type M4 material as specified in Section 31 05 16.

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 a minimum of 4 percent and a 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 the same source throughout the Work.

PART 3. EXECUTION

3.1 EXCAVATION

- A. Excavate topsoil from areas designated—Strip topsoil to the 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 the site.
- D. Remove excavated materials not meeting requirements for topsoil materials from the 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 the stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile and leave the 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 the 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 11 23 AGGREGATE BASE COURSE

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate Base Course.

B. Related Sections:

1. Section 31 05 16 – Aggregate Materials.
2. Section 31 23 33 – Trenching and Backfilling for Pipelines and Utilities: Compacted fill under base course.
3. American Public Works Association (APWA) Specifications (latest version)

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-pounds/foot³ (2,700 kN-m/m³))
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5. 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. Manufacturer's Certificate: Certify Products that meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from a single source throughout the Work.

PART 2. PRODUCTS

2.1 MATERIALS

- A. Aggregate Base Course Type M6: As specified in Section 31 05 16 – Aggregate Materials.

PART 3. EXECUTION

3.1 EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

- A. Spread aggregate over prepared substrate to a total compacted thickness as noted on the plans.
- B. Place aggregate in maximum 6-inch layers and compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.
- C. Maximum Variation From Thickness: 1/4 inch.
- D. Maximum Variation From Elevation: 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Testing, adjusting, and balancing.
- B. Compaction testing will be performed in accordance with ASTM D1556. ASTM D1557. ASTM D2167. ASTM D2922. ASTM D3017.

- C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- D. Frequency of Tests: 1000 feet or as specified by Engineer.

3.6 COMPACTION

- A. Compact placed aggregate materials uniformly to achieve required compaction.

END OF SECTION

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SECTION 31 23 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 11 20 – Soil Materials.
2. Section 31 05 16 – Aggregate Materials.
3. Section 31 10 00 – Site Clearing: Excavating topsoil.
4. Section 31 23 16 – Excavation: Building excavation.
5. Section 31 23 23 – Backfilling for Structures: General building area backfilling.
6. Section 31 23 33 – Trenching and Backfilling for Pipelines and Utilities.
7. American Public Works Association (APWA) Specifications (latest version)

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/foot³ (600 kN-m/m³)).
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/foot³ (2,700 kN-m/m³)).
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 M1 as specified in Section 31 05 16.
- D. Aggregate Base Course: Type M6 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.
 - 1. Slope grade away from structure minimum two inches in 10 feet unless noted otherwise.
- C. Make grade changes gradual. Blend slope into level areas.
- D. Repair or replace items indicated to remain damaged by excavation or filling.

3.5 TOLERANCES

- A. Section 01 40 00 – Quality Requirements: 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 Requirements: 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 16 EXCAVATION

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil densification.
2. Excavating for building foundations.
3. Excavating for slabs-on-grade.
4. Excavating for site structures.

B. Related Sections:

1. Section 31 23 23 – Backfilling for Structures
2. Section 31 23 33 – Trenching and Backfilling for Pipelines and Utilities
3. American Public Works Association (APWA) Specifications (latest version)

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/ft³ (600 kN-m/m³)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

B. Local utility standards when working within 24 inches of utility lines.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION

3.1 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.

3.2 EXCAVATION

- A. Excavate subsoil to accommodate structure foundations, slabs-on-grade, and construction operations.
- B. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with specifications and Geotechnical Engineering Report.
- C. Slope banks with machine to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Trim excavation. Remove loose matter.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- H. Notify Engineer of unexpected subsurface conditions.
- I. Correct areas over excavated with structural fill Type A1 specified in Section 31 05 16.
- J. Stockpile excavated material in area designated on site in accordance with Section 31 11 20 – Soil Materials.
- K. Repair or replace items indicated to remain damaged by excavation.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Testing and Inspection Services.
- B. Request visual inspection of bearing surfaces by Engineer before installing subsequent work.

3.4 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

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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 03 30 00 – Cast-in-Place Concrete: Concrete materials.
2. Section 31 05 16 – Aggregate Materials
3. Section 31 11 20 – Soil Materials
4. Section 31 22 13 – Rough Grading: Site filling
5. Section 31 23 16 – Excavation
6. Section 31 23 33 – Trenching and Backfilling for Pipelines and Utilities: Backfilling of utility trenches.
7. American Public Works Association (APWA) Specifications (latest version)

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/foot³ (600 kN-m/m³)).
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/foot³ (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. Granular Backfill: Type M2 as specified in Section 31 05 16.
- C. Stabilization Fill: Type M5 as specified in Section 31 05 16.
- D. Aggregate Base Course: Type M6 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 Requirements: Tolerances.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: 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 70 00 – Execution and Closeout Requirements: Protecting finished work.
- B. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 33
EXCAVATION AND BACKFILL FOR PIPES AND UTILITIES

PART 1. GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavation for pipelines and utilities.
2. Compacted bedding over pipelines and utilities.
3. Backfilling and compaction.

B. Related Sections

1. Section 01 40 00 – Quality Requirements.
2. Section 01 52 00 – Construction Facilities.
3. Section 31 23 19 – Dewatering.
4. Section 31 22 13 – Rough Grading.
5. Section 31 23 16 – Excavation.
6. Section 31 23 23 – Backfilling for Structures.
7. Section 40 06 00 – Pipe and Fittings.
8. American Public Works Association (APWA) Specifications (latest version)

1.2 REFERENCES

- A. American National Standards Institute (ANSI)/ASTM International (ASTM) C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-pound (4.54 Kg) rammer and 18-inch (457 mm) drop.
- D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 Submittal Procedures.

1.4 FIELD MEASUREMENTS

- A. Verify that the survey benchmark and intended elevations for the Work are as shown on the drawings.

PART 2. PRODUCTS

2.1 BACKFILL MATERIALS

- A. Aggregate Materials: Types P1, P2, P3, and P4 as specified in Section 31 05 16.

2.2 BEDDING MATERIALS

- A. Ductile Iron Pipe - Type P2 as specified in Section 31 05 16.
- B. PVC or Polyethylene Pipe – Type P3 as specified in Section 31 05 16.

PART 3. EXECUTION

3.1 EXAMINATION

- A. Verify fill materials are to be reused if acceptable.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify, maintain and protect existing utilities remaining that pass through the work area.
- C. Protect benchmarks, existing structures, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- D. Protect above and below grade utilities that are to remain.
- E. Cut out soft areas of subgrade not capable of in situ compactions. Backfill with Type P1 fill, Section 31 05 16, and compact to density equal to or greater than requirements for subsequent backfill material to a point four inches below the bottom of the pipe.
- F. Provide means by which natural drainage ways can be diverted away during trenching. Do not permit runoff water to enter the trench.

3.3 EXCAVATION

- A. Dewater as necessary. See Section 31 23 19 - Dewatering.
- B. Underpin adjacent structures which may be damaged by excavation.
- C. Have utility poles supported, which may become undermined by excavation.
- D. Excavate subsoil required for water piping, sewer piping, culverts, and other utilities.

-
- E. Cut trenches sufficiently wide to enable safe installation of utilities and allow review, meeting dimensions shown on the plans. Minimize the length of open trenches.
 - F. Excavation shall not interfere with a normal 45-degree bearing splay of foundations.
 - G. Provide trench bracing in strict accordance with safety standards.
 - H. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
 - I. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard, measured by volume.
 - J. Correct unauthorized excavation using suitable backfill materials at no cost to the Owner.
 - K. Correct areas over excavated by error using suitable backfill materials, at no cost to the Owner.
 - L. Stockpile excavated material in an area designated on site.
 - M. Provide means for removing groundwater from the trench. No pipe shall be laid in a trench with standing water in it.

3.4 BEDDING

- A. Support pipe and conduit during placement and compaction of bedding.

3.5 BACKFILLING

- A. Backfill trenches 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. Granular Fill: Place and compact materials in continuous layers not exceeding eight inches of loose depth.
- D. Soil Fill: Place and compact material in continuous layers not exceeding eight inches of loose depth.
- E. Employ a placement method that does not disturb or damage pipe in the trench.
- F. Maintain moisture content within two percent of optimum moisture content for fill materials to attain the required compaction density.
- G. Leave fill material stockpile areas completely free of excess fill materials.

3.6 FIELD QUALITY CONTROL

- A. Field review and testing will be performed under provisions of Section 01 40 00.

-
- B. Tests and analysis of fill material, if required by the Engineer, will be performed in accordance with ANSI/ASTM C136 and with Section 01 40 00 Quality Requirements.
 - C. Compaction testing, if required by the Engineer, will be performed in accordance with ANSI/ASTM D1556, ANSI/ASTM D1557, and Section 01 40 00 Quality Requirements.
 - D. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no cost to the Owner.
 - E. Frequency of Compaction Tests: (Trench)
 - 1. Horizontal Location:
Test at the start of the trench with subsequent tests at every 100 feet along the trench length.
 - 2. Vertical Location:
At every horizontal location, obtain one test at half the depth of the trench, one test at the top of the trench, and subsequent test(s) at locations where materials or construction procedures change.

3.7 PROTECTION OF FINISHED WORK

- A. Protect trench excavation to prevent a cave-in.
- B. Maintain and protect finished Work until the project is completed.
- C. Recompact fills are subjected to vehicular traffic.
- D. Protect excavations by use of trench box or other approved method to prevent cave-in and to limit trench width.

3.8 SCHEDULE

- A. Gravity sewer pipes and sewer force mains:
 - 1. Compaction: Under pavements or other surface improvements, the in-place density shall be at least 95 percent of the maximum dry density as determined by ASTM D1557. In other areas, the in-place density shall be at least 95 percent of the maximum standard density as determined by ASTM D698 unless otherwise specified.
 - 2. Foundation Placement: Type P1. The foundation material shall be placed so the trench can be properly fine-graded as specified. The foundation material shall be deposited over the entire trench width and compacted in layers. The layers shall have a maximum uncompacted thickness of six inches.
 - 3. Bedding: Type P2 or Type P3. The bedding material shall be deposited over the entire trench width to a compacted thickness of no less than four inches. The material shall have a maximum uncompacted thickness of six inches.

-
4. Initial Backfill: Type P2 or P3. After the pipe is in place, initial backfill material shall be placed at any point below the mid-point of the pipe simultaneously and uniformly on both sides of the pipe in un-compacted layers not to exceed 10 inches or one-half the diameter of the pipe, whichever is less. Initial backfill shall be placed with care to prevent displacement of or damage to the pipe and not drop into the trench in compact masses. The section of the pipe zone from the mid-point of the pipe to 12 inches above the top of the pipe shall then be filled with initial backfill materials and compacted.
 5. Final Backfill: Type P4. The final backfill shall be from 12 inches above the top of the pipe to the level shown on the Drawings.

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 manholes.
- B. Precast concrete boxes and catch basins.
- C. Precast concrete vaults.
- D. Miscellaneous precast concrete structures for utility use.
- E. Bedding and cover materials.

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: Reinforced precast concrete in accordance with Mt Pleasant City or APWA standards.
- 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:
 - 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: D&L 1800 or equivalent cast iron construction, machined flat bearing surface, removable lid, and cover molded with identifying name per Mt Pleasant City or APWA standards.
- C. Size: As indicated on the Drawings.

2.3 COMPONENTS

- A. Manhole and Structure Steps: Polypropylene plastic covered galvanized steel reinforced bar rungs; 1/2-inch diameter, meeting ASTM C478, ASTM D4101, and ASTM A615.
- B. Grout: As specified in Section 03 30 00 - Cast-in-Place Concrete.
- C. Manhole and Structure Gaskets: Conform to ASTM C-443, or Ram-Nek Sealant or approved equivalent.
- D. Manhole and Structure Connectors: Conform to ASTM C923.
- E. Bedding: Structural Fill aggregate material as specified in Section 31 05 16.

2.4 CONFIGURATION

- A. Manholes:
 - 1. Typical Pipe Cover Areas:
 - a. Shaft Construction: Concentric with cone top section; lipped male/female dry joints; sleeved to receive pipe and conduit sections.
 - 2. Reduced Pipe Cover Areas:
 - a. Shaft Construction: Concentric with eccentric flat top section; lipped male/female dry joints; sleeved to receive pipe and conduit sections.
 - 3. Shape: Cylindrical.
- 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: Fill Type M1, as specified in Section 31 05 16 and the Geotechnical Report.
- B. Backfill: Fill Type M2, as specified in 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 manholes and 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 (Type A3 aggregate material) 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 33 30 00 SEWER BYPASS PUMPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sewage bypass pumping requirements, controls and procedures.

1.2 RELATED SECTIONS

- A. Section 01 10 00 – Work Summary
- B. Section 01 33 00 – Submittals
- C. Section 01 52 00 – Construction Facilities

1.3 DESCRIPTION AND GENERAL REQUIREMENTS

- A. Furnish all labor, materials, equipment, and incidentals required to maintain continuous and reliable sanitary sewer service during construction.
- B. During various phases of the Work, it will be necessary to construct and maintain temporary bypass sewers to maintain continuous and reliable sewer flow in all pipes, including individual service connections. Various phases of the Work that may require the implementation of temporary bypass sewers.
- C. Contractor shall construct and maintain all temporary bypass sewers and be responsible for all bypass pumping of high and low sewage flow that may be required to prevent backing up of sewage and allow appropriate conditions for proper inspection, rehabilitation, testing or drainage during the work.

1.4 SUBMITTALS

- A. The design, installation, operation, and maintenance of the temporary bypass pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- B. Submit a sewage bypass control plan that includes the following:
 - 1. The locations of pumps;
 - 2. Schedule when bypass pumping operations will occur, coordinated with work sequence;
 - 3. Contingency plan for equipment or power failure, including manual and automatic controls
 - 4. Emergency notification protocols and sequence of contact persons in case of primary system failure.

5. Spill response plan;
6. Operation and maintenance manual of equipment;
7. Sewer plugging location and type of plugs;
8. Proposed number, type, and capacity of bypass pump(s) and piping and power requirements. Include product data on all equipment to be used;
9. Number, size, material, location and method of installation of suction piping;
10. Number, size, material, method of installation and location of installation of discharge piping;
11. Calculations of pumping system friction losses (including suction losses), suction and discharge velocities. Include a pump curve with a system curve showing pump operation for high and low suction conditions;
12. Provide the seal of a Professional Engineer (PE) licensed in the State of Utah on the bypass pumping drawings and supporting engineering calculations.
13. Temporary pipe supports and anchoring required;
14. Example notification flyer for notifying impacted residents and stakeholders.

PART 2 PRODUCTS

2.1 BYPASS PRODUCTS

- A. All pumps shall be automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps must be designed and constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows. Sewer bypass systems shall meet city noise ordinances.
- B. Bypass piping shall be constructed of jointless pipe. The pipe joints and pressure rating shall match the pumping conditions. Aluminum irrigation type piping or glued polyvinyl chloride (PVC) pipe shall not be permitted. Discharge hose shall only be allowed in short sections. The pipe shall be free of punctures or any leaks throughout the operation.

PART 3 EXECUTION

3.1 DEMONSTRATION

- A. The bypass control system shall adequately and continuously convey all wastewater flows during construction. The Contractor shall be responsible for continuity of sanitary sewer service to each facility and residence connected to the section of sewer main during the execution of the work.
- B. Prepare contingency plans for equipment or power failure and unexpected conditions. Sewage bypass pumping shall provide for 100 percent backup redundancy.
- C. Prepare all necessary diversions and modifications in accordance with the submitted plan.

- D. Provide independent temporary power sources for sewage bypass pumping equipment. Provide all necessary temporary electrical service to machinery and provisions for backup power generation. Provide experienced and qualified personnel to operate and maintain system function throughout the bypassing period. Provide all temporary lighting and safety control systems.
- E. Startup testing procedure:
 - 1. Air pressure test the bypass piping to 15 psi and hold for 15 minutes prior to putting the pipe into service
 - 2. Contractor shall operate the sewage bypass system for a 2-hour trial period during expected peak flows under observation by the Owner or Engineer before bringing the bypass system online. If the bypass system fails or deficiencies are noted, the contractor shall correct the problem(s) and restart the trial period at no additional cost to the Owner. Trial period shall continue until the Owner and Engineer deem it to be completed
- F. If discharging to new downstream sewers, verify that they have passed leakage testing and are approved for receiving wastewater flows.
- G. Bypass of sewage shall be in enclosed piping. Wastewater is not permitted to flow in open trenches. Temporary gravity flow diversions through structures with partial pipes and/or baffles with concrete channels may be permitted with Owner and Engineer approval.
- H. Install discharge piping in a manner to provide safe and reliable service, without disrupting public access and incorporation with the Traffic Control Plan. Report spillage immediately to Owner and Engineer. Isolate the contaminated area from the public and execute containment and remediation procedures.

3.2 BYPASS PUMPING SYSTEM REQUIREMENTS

- A. The bypass systems shall have sufficient capacity to pump peak hourly flows that are seen at the lagoons, it is assumed that the peak hourly flow will be **500 Gallons Per Minute (GPM)**. An updated peak hourly flow will be determined after analysis of the existing flow meter data. A safety factor of 1.2 shall be used when sizing pumps, pipes, and all other apparatuses.
- B. The bypass shall be made by temporarily plugging the line to be isolated at the upstream manhole and pumping the flow into a downstream manhole.
- C. Sewage flow shall be maintained at all times around the construction operations. Contractor shall be responsible for the continuity of sanitary sewer service to each connection within the sewer reach being rehabilitated during execution of the work.
- D. Bypass control systems shall not surcharge or in any way affect the full operating capacity of the upstream or downstream trunk sewers. Surcharging shall be defined as depth of flow above the pipe crown.

- E. The bypass system shall have a high level switch to initiate a local horn, an alarm/phone dialer, and emergency light or beacon. The contractor shall provide automatic stop/start controls for each pump.
- F. The contractor shall take all necessary precautions and shall be liable for all cleanup, damages and resultant fines caused by sewage bypass system spills.
- G. Implement contingency plans for equipment or power failure and unexpected flow conditions. These plans shall be provided to the Engineer prior to operation.
- H. Implement all necessary diversions and modifications in accordance with submitted plan.
- I. During all bypass pumping operation, the Contractor shall protect lift stations, sewer mains, and all sewer services from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to sewer system facilities caused by human or mechanical failure.
- J. When completed with work, Contractor shall return flow slowly to normal to prevent surge.

3.3 MONITORING

- A. The Contractor shall provide a qualified operator for continuous manned monitoring of the bypass pumping, and in no circumstance should the system be left without human surveillance, surveillance shall occur both upstream and downstream of the point being isolated as well as service lines that require bypassing in addition with an alarm/phone dialer. Bypass pumping at night will be permitted only with Owner and Engineer approval.
- B. The responsible operator selected to monitor the bypass system shall be proficient in operating the bypass pumping and piping system. These individuals shall have experience in properly switching pipes, pumps, and power sources quickly in case of failures and unclogging pumps in case they become plugged.

3.4 SEQUENCING AND SCHEDULING

- A. Prior to starting construction, the contractor and the bypass pumping team will have a meeting to discuss the bypass pumping plan with the owner and the engineer.

3.5 TERMINATION

- A. Remove equipment and appurtenances upon termination of sewage bypass control activities and restore disturbed area to original condition.
- B. Clean any sewer mains or manholes which have been surcharged.

END OF SECTION

SECTION 40 05 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

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 positioned 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 "PITWRAP 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-degrees 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.

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 Restraint 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:

$$Length = \left(\frac{Test\ Pressure}{150} \right) (Table\ Value)$$

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 hangers, 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 sole 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

PVC01

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.	

PVC02

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.	

PVC03

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.	

PVC04

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: <ul style="list-style-type: none"> 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.

PVC05

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 Cermapure 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: <ul style="list-style-type: none"> 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)			
<u>DI01</u>			
	MATERIAL:	Cement mortar	
		MATERIAL STANDARD:	ANSI/AWWA C104/A21.4
<u>DI02</u>			
	MATERIAL:	Epoxy	
		MATERIAL STANDARD:	See Note 6
<u>DI03</u>			
	MATERIAL:	Glass Lining	
		MATERIAL STANDARD:	See Note 7.
<u>DI04</u>			
	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: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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 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 	

GENERAL DESCRIPTION:	Ductile Iron Pipe
SIZE:	3- through 48-inch nominal diameter
	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>ix. Handle pipe according to lining manufacturer's recommendations.</p> <p>x. Taps and welds shall be done before lining. Field cut and repair field cuts in accordance with manufacturer's recommendations.</p>
8.	Pipe manufacturer shall be McWane Ductile, U.S. Pipe, or approved equal.
9.	<p>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.</p> <p>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.</p>
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 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”, conforming to MSS SP 43, wall thickness same as pipe.

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe		
SIZE:	2- through 30-inch nominal diameter		
		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.	<p>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.</p> <p>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.</p> <p>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.</p>		
3.	<p>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 shall be taper bored at a 3:1 slope to provide a smooth transition of inside diameters.</p> <p>Machine grooves into pipe end (Schedule 40, minimum) in accordance with grooved fitting manufacturer's recommended dimensions, tolerances, and finishes.</p> <p>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.</p>		
4.	Shop Fabricated Assemblies:		

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe
SIZE:	2- through 30-inch nominal diameter
	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> ○ 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. ○ 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: <ul style="list-style-type: none"> ○ Align ends to be joined within commercial tolerances on diameter, wall thickness, and out-of-roundness. ○ 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. ○ Root opening at the joint shall be as stated in the procedure specification. • Welding: <ul style="list-style-type: none"> ○ 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. ○ 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: <ul style="list-style-type: none"> ○ All tack welds shall be made by a qualified welder. ○ All tack welds shall be made with welding rod the same as that used for the succeeding root pass. ○ Tack welds shall be small enough to be readily fused into the bead of the root pass. ○ 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.	<p>For connections requiring field assembly:</p> <ul style="list-style-type: none"> • Welded: Field welding of stainless steel piping connections will not be allowed.

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe
SIZE:	2- through 30-inch nominal diameter
	<ul style="list-style-type: none"> ○ 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. <ul style="list-style-type: none"> ▪ 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. <ul style="list-style-type: none"> ▪ LIQUID SERVICE: <ul style="list-style-type: none"> • <i>Style: Segmented and bolted. Victaulic, Style 77; or equal</i> • Victaulic Style 232S restrained flexible coupling with EPDM gasket ▪ AIR SERVICE: <ul style="list-style-type: none"> • <i>Victaulic Style 232S restrained flexible coupling with silicone gaskets suitable for use with air and rated to 300°F.</i>
6.	<p>CLEANING, DESCALING, PICKLING AND PASSIVATING</p> <ul style="list-style-type: none"> • All stainless steel piping, fabrications, fittings and assemblies shall be shop fabricated and shall be cleaned, descaled, pickled and passivated per ASTM A380-06, ASTM A967-05 and Ferroxyl Inspected per ASTM A967-05. <ul style="list-style-type: none"> ○ 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. ○ 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.	<p>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.</p>

GENERAL DESCRIPTION:	Large-Diameter Type 304L Stainless Steel Pipe
SIZE:	2- through 30-inch nominal diameter
8.	<p>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.</p> <p>Grooved Joints: Type 316 stainless steel. Grade B-8M, Class 2; coupling manufacturer's standard size and shapes.</p>

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, 1/8-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, 1/8-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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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 single wide-arch expansion joint), or approved equal
	NOTES:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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 05 11 PIPE SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

- A. Contractor shall provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.
- B. Contractor shall design and provide pipe supports in accordance with this Section. Pipe support details on the Plans (including standard details) are representative only. References to details in the Plans and the design notes included therein establish the general need for a pipe support (e.g. at connections to equipment to prevent load transfer, points in piping systems where maintenance or disassembly is required, etc.) and are provided to communicate minimum criteria. The absence of pipe supports and details on the Plans does not relieve the Contractor of responsibility for sizing and providing all necessary pipe supports.
- C. The provisions of this Section shall apply to piping in Division 40.
- D. Contractor shall be responsible for the complete engineering design and detailing of all pipe supports and anchorage.
 - 1. Unless noted otherwise, pipe support details indicated in the Contract Drawings are based on gravity loads only and not designed to resist hydraulic transients, seismic loads, and wind forces.
 - 2. Pipe support details indicating "SEISMIC AND WIND COMPLIANT DESIGN CRITERIA" on the drawings are designed to resist seismic and wind forces within the limits of the seismic and wind design criteria indicated in the detail.
 - 3. Include pipe weight and assume pipe is full of water at 68° F.
 - 4. Include hydraulic transient loads of twice the operating pressure, unless noted otherwise.
 - 5. Design shall accommodate thermal expansion and contraction – reference climatic data in Section 01 10 00 Summary of Work for range of potential ambient temperatures. For compressed air piping, assume a potential temperature rise of 250° F above ambient.
 - 6. The configuration and location of pipe supports, if specifically indicated on the Plans, shall be adhered to unless approved otherwise by the Engineer.

- E. The Contractor shall provide the services of a Registered Professional Engineer experienced in pipe support design to design and detail the pipe supports and anchorage.
- F. Piping support and anchorage design and detailing shall be in accordance with the International Building Code and Section 01 60 10 Design Requirements for Non-Structural Components and Non-Building Structures.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 Submittal Procedures.
- B. Shop Drawings shall include the following information as a minimum:
 - 1. Drawings of pipe supports, hangers, anchors, and guides.
 - 2. Pipe support schedule or layout indicating where the supports will be installed.
 - 3. Calculations and details for pipe supports and anchors

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Code Compliance
 - 1. Piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, and probable forces applied during construction as well as stresses on piping, equipment, and structures.
 - 2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping – Part 5 -Expansion, Flexibility, and Pipe Supporting Element and design the pipe supporting elements in accordance with the rules of MSS SP-58 - Pipe Hangers and Supports – Materials, Design and Manufacture, except as supplemented or modified in this Section.
 - 3. Supports for plumbing piping shall be in accordance with the latest edition of the applicable Plumbing Code or local administration requirements.
- B. Structural Members
 - 1. Wherever possible, pipes shall be supported from structural members.
 - 2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the Contractor.

3. Supplementary members shall be in accordance with the requirements of the Building Code and the American Institute of Steel Construction, and shall be as acceptable to the Engineer.

C. Pipe Hangers

1. Pipe hangers shall be capable of supporting the pipe in operation, allowing free expansion and contraction of the piping and preventing excessive stress on equipment.
2. Hangers shall have a means of vertical adjustment after erection.
3. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe.
4. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors.
5. Hanger rods shall be subjected to vertical loading only.

D. Hangers Subject to Lateral or Axial Movement.

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.
2. Where lateral or axial pipe movement is greater than 1/2 inch, or where the hanger rod deflection from the vertical is greater than four degrees from the cold-to-hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Spring-Type Hangers

1. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping.
2. Spring-type hangers shall be sized per the manufacturer's printed recommendations and for the loading conditions encountered.
3. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate the compression of the spring.
4. Supports shall be capable of accommodating at least four times the maximum travel due to thermal expansion.

F. Thermal Expansion

1. Wherever expansion and contraction of piping is expected (e.g. compressed air piping, exposure to sunlight, intermittent operation, etc.), a sufficient number of

expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely away from the anchored points.

2. Components shall be structurally suitable to withstand the imposed loads.

G. Heat Transmission

1. Supports, hangers, anchors, and guides shall be designed and insulated such that excessive heat will not be transmitted to the structure or to other equipment.

H. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

I. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to support frames fabricated from angles, channels, or I-beams anchored to the structure.
2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

J. Materials of Construction

1. Pipe support assemblies shall be as follows:
 - a. Interior above finished floor: steel construction and hot-dipped galvanized per ASTM A 123
 - b. Interior inside wet wells, tanks, vaults, manholes, and similar: 316 stainless steel
 - c. Chemical Rooms: Type 316 stainless steel, or FRP if indicated on the Plans.
2. All hardware, fasteners, anchor bolts, and appurtenances shall be 316 stainless steel.

K. Point Loads

1. Meters, valves, heavy equipment, and other point loads on polyvinyl chloride (PVC), fiberglass reinforced plastic (FRP), or other plastic pipes, shall be supported on both sides of the item, according to manufacturer's recommendations, in order to avoid undue pipe stresses and failures.

2. In order to avoid point loads, the supports on PVC, FRP, or other plastic piping shall be equipped with extra wide pipe saddles or load-distributing shields.

L. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table; consult the Engineer for any anchor applications not appearing on the table.
2. Cast-in-place anchors shall be Type 316 stainless steel. Post-installed anchors shall be in accordance with ACI 318-14. Anchor embedment shall be in accordance with the Contract Documents and the anchorage calculations; where a discrepancy exists, the deeper embedment shall be provided unless otherwise approved by the Engineer.

Pipe Support Application	Type of Concrete Anchor
New Concrete	<p>Use embedded concrete insert anchors on a grid pattern. Use Grinnell (Anvil International), Tolco, or equal.</p> <p>Use cast-in-place anchors where indicated.</p>
Existing Concrete	<p>Use non-shrink grouted anchors, expansion anchors, or epoxy anchors. Epoxy anchors are not permitted for vertical hanging applications or where sustained tension is exerted on the anchor.</p> <p>Exceptions: Expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 degree F or higher than the limiting temperature recommended by the manufacturer.</p>
Vibratory Loads and High-Temperature Conditions	Use non-shrink grouted anchors.

M. Noise Reduction

1. In order to reduce the transmission of noise in piping systems, copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

- A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with

special consideration given where components such as flanges and valves impose concentrated loads.

- B. Where pipe spacing are indicated on the Drawings and are referenced to a Standard Detail, that requirement shall take preference over the general requirements of this section.
- C. Pipe support spacing shall not exceed the maximum indicated spans. Piping with grooved joint couplings, flexible joints, and bend fittings shall be balanced supported by a minimum of two pipe supports per pipe length, one at near each joint/fitting.
- D. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations.
- E. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.
- F. **Steel Pipe**
 - 1. Where support spacing is not indicated on the Drawings, the Contractor shall use the spacing below as a minimum.
 - 2. Support Spacing for standard wall or heavier welded steel, stainless steel or alloy steel pipe.

Nominal Pipe Diameter, Inches	Maximum Span, ft (Water Service)	Maximum Span, ft (Gas or Vacuum Service)
1/2	6	7
3/4 and 1	8	9
1-1/4 to 2	10	12
3	12	14
4	14	15
6	16	18
8 and 10	18	20
12 and 14	20	24
16 and 18	22	26
20 and greater	24	30

- G. **Ductile Iron Pipe**
 - 1. Install supports for ductile iron pipe in accordance with the recommendations of the Ductile Iron Pipe Research Association (DIPRA) Design of Ductile Iron Pipe on Supports.

2. As a minimum, where support spacing is not indicated on the Drawings, the Contractor shall use the spacing indicated in the following schedule:

Nominal Pipe Diameter, Inches	Support Configuration
All diameters	Two supports per pipe length, with one of the two supports located at a joint.

H. Copper Tube

1. Where support spacing is not indicated on the Drawings, the Contractor shall use the spacing below:

Nominal Tube Size, inches	Support Spacing, feet	
	Water Service	Vapor Service
3/4 and smaller	5	5
1	6	8
1-1/2 to 2-1/2	8	10
3	10	14
4	12	16
5	13	18
6	14	20
8	16	23

I. Schedule 80 PVC and CPVC Pipe

Nominal Pipe Size, inches	100°F and below	101 to 120 °F	121 to 140 °F
1	5	3.5	3
1-1/2	5.5	3.5	3.5
2	6	4	3.5
3	7	4.5	4
4	7.5	5	4.5
6	9	6	5
8	9.5	6.5	5.5
10 and larger	10	7	6

J. Other Pipe Materials

1. Support spacing for pipe constructed of other materials shall be based on design temperature and in accordance with the pipe manufacturer's recommendations.

2.3 MANUFACTURED SUPPORTS

A. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.
2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

B. Manufacturers, or Equal

1. Basic PSA, Inc.
2. Bergen-Paterson Pipe Supports Group
3. Grinnell
4. Power Piping Company
5. TOLCO (Eaton B-Line)

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's printed instructions and per American National Standards Institute (ANSI)/Manufacturers Standardization Society (MSS) SP-58 Pipe Hangers and Supports- Materials, Design, Manufacture, Selection, Application and Installation.
2. Embedded concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.

2. Hanger rods shall be vertical, without offsets.
3. Hangers shall be adjusted to line up groups of pipes at the proper slope for drainage and venting, as close to ceilings or roofs as possible, and without interference with other WORK.

3.2 FIELD FABRICATION

A. Quality Control

1. Field fabricated pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.
2. Hangers and supports shall be neat in appearance without sharp corners, burrs, or edges.

END OF SECTION

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SECTION 40 05 59 STAINLESS STEEL SLIDE GATES AND WEIR GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section covers stainless steel slide gates, stop gates, weir gates and operators as shown on the plans, listed in the gate schedules and as specified herein.
- B. The equipment provided 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.
- C. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.
- D. Refer to the gate schedule on Sheet 00-G-018 in the Contract Drawings.

1.2 REFERENCES

- A. ASTM International ASTM A276 – Stainless steel bars and shapes
- B. American Water Works Association (AWWA) C561 - latest edition
- C. ASTM D4020 – Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials

1.3 DEFINITIONS

- A. A weir gate is a downward opening slide gate with flow over the top.

1.4 DESIGN REQUIREMENTS

- A. Gate configuration, components and accessories shall be of the size and type shown on the drawings and gate schedule and specified herein.
- B. Gates shall be designed for continuous immersion in raw wastewater.
- C. Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA-C561 standards.
- D. Leakage: Gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.05 US gallons per minute per foot of seating perimeter. Under the design unseating head, leakage shall not exceed 0.05 US gallons per minute per foot of perimeter.

1.5 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 and Divisions 43, 46 with the following additional information:
 - 1. Fabrication drawings with full dimensions, construction and installation details, and materials used on all parts of the gate, operator, lift, and appurtenances. General arrangement drawings and cut sheets are not considered acceptable drawings.
 - 2. Plan, cross section, and details showing proposed mounting for each size and typical application of gate.
 - 3. Applicable operation and maintenance information as specified in Section 01 73 00.
 - 4. Complete engineering design calculations in compliance with AWWA standards, latest edition.

1.6 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 (1) 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.

1.7 QUALITY ASSURANCE

- A. The gate manufacturer shall have a minimum of five (5) years of experience producing equipment substantially similar to that required and shall be able to submit documentation of at least fifteen (15) independent installations using the same size or larger equipment as detailed below. Each installation must have been in satisfactory operation for at least five (5) years.
- B. The contract documents represent the minimum acceptable standards for the equipment. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. The entire unit shall be 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 specification.
- C. Fabrication shall be done in compliance with all applicable ASTM standards or equivalent international standards.
- D. The manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirement of the latest edition of American Welding Society (AWS) Sections D1.1, 1.2, and 1.6.

- E. The Contractor or Subcontractor responsible for the installation of the gates shall have five or more years of experience in the installation of similar type gates.
- F. All fully assembled gates shall be shop inspected, tested for operation and leakage, and adjusted before shipping. There shall be no assembling or adjusting on the job sites other than for the lifting mechanism.

1.8 DESIGN REQUIREMENTS

- A. Gate configuration, components, and accessories shall be of the size and type shown on the Drawings and gate schedule and specified herein.
- B. Gate, frame, and yoke design shall be such that the flexural stress does not exceed 10,000 pounds per square inch (psi) or that the minimum safety factor is 5-to-1 based on the ultimate strength of the material used.
- C. Gate shall be designed for continuous immersion in raw wastewater. Fluid temperature is expected to range from 35°F to 90°F.
- D. Except as modified or supplemented herein, gate and operators shall conform to the applicable requirements of AWWA-C561 standards.
- E. Leakage: Gate shall be substantially watertight under the design head conditions. Under the design seating and unseating heads, the leakage shall not exceed 0.05 US gallons per minute per foot of seating perimeter.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. In order to ensure uniform quality, ease of maintenance and minimal parts storage, all gates supplied under this section shall be supplied by a single manufacturer unless noted otherwise.
 - 1. Whipps
 - 2. Golden Harvest, Inc.
 - 3. RW Gate Company
 - 4. Waterman
 - 5. Rodney Hunt
 - 6. Approved Equal

2.2 MATERIALS AND CONSTRUCTION

- A. General Design
 - 1. Gates shall be either self-contained or non-self-contained of the rising stem or non-rising configuration as indicated on the gate schedule.

2. All parts of the gate shall have a minimum thickness of ¼-inch.
- B. Frame
1. Gate frame shall conform to the safety factors specified in AWWA C561.
 2. Gate frame shall be designed for embedding, in-channel, or face mounting as showing on the drawings or gate schedule.
 3. The gate frame shall be stainless steel and designed for maximum rigidity.
 4. The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the wall.
 5. Lifting Lugs shall be provided on frame styles.
 6. Frame shall be single piece construction; bolted frames are not acceptable. Wraparound gussets shall be provided where frame stresses require additional reinforcement.
- C. Slide
1. Gate slide shall conform to the safety factors specified in AWWA C561 but shall, in no case, be less than ¼-inch thick. The slide shall consist of a stainless-steel plate that is reinforced with horizontal and vertical stiffeners. The stem connector clips or stem block pocket shall be welded to the slide. Horizontal reinforcement members welded to side vertical members. The slide shall consist of stainless-steel plate reinforced to limit its deflection. The limits of deflection shall be:
 - a. Slide Gate: $L/720$ of the gate's span under the design head or 1/16 inch, whichever is less.
 - b. Weir Gate: $L/720$ of the gate's span under the design head or 1/16 inch, whichever is less.
- D. Guides and Seals
1. The guides shall be provided with ultra-high molecular weight polyethylene seats on both sides of the slide and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.
 2. Guide frame shall not weigh less than 13 pounds per foot.
 3. Slide gate shall incorporate a flush-bottom seal that is attached to the bottom frame invert member. The seal shall be of the materials listed in "Materials of Construction" and shall meet the material test requirements specified in AWWA C561.
 - a. The design of the seal shall be such as to provide resistance against leakage, as specified in AWWA C561.
 4. Top and side seals shall be self-adjusting ultra-high-molecular-weight polyethylene (UHMWPE) with compression cord and securely fastened to the

frame with formed stainless-steel retainers and shall be replaceable and adjustable in the field without disassembly of the frame and removing the gate from the installed position. The corners of the seals shall be vulcanized. Bottom seal to be UHMWPE.

- a. When required for shutoff purposes, a neoprene top seal shall be mounted to the top member.

E. Yoke and Pedestal

1. The yoke, to support the operating bench stand, shall be formed by two structural members welded at the top of the guides to provide a one-piece rigid frame.
2. Self-contained gates shall be provided with a yoke to support the operating bench stand. The yoke shall be formed by two structural members welded at the top of the guides to provide a one-piece rigid frame. The maximum deflection of the yoke shall be $L/360$ of the gate's span.

2.3 LIFTING ASSEMBLIES

A. Stem and Couplings

1. The operating stem shall be of stainless steel designed to transmit in compression at least two times the rated output of the operating manual mechanism with a 40-pound effort on the crank. The operating stem shall be rising and shall be designed to withstand both tension and compression loads. For manual actuators the tension and compression design loads shall be those caused by the application of an 80-lb effort on the crank or handwheel or a 100-pound-foot torque on a wrench nut. The tension design load shall not exceed one-fifth of the ultimate tensile strength of the stem material. The compression design load shall be less than the critical buckling load as determined by AWWA C561.
2. Threads: Stems shall have rolled or American Standard general purpose full depth dual lead Acme type threads with a maximum roughness of 16 micro-inches. The stem shall be supported by angle guides or cast iron stem guides with a two-piece cast bronze guide collar, spaced to provide an L/R ratio of 200 or less.
3. Where a hydraulic, pneumatic or electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic or pneumatic cylinder with a pressure equal to the maximum working pressure of the supply, or 1.25 times the output thrust of the electric motor in the stalled condition.
4. Coupling: Stem lengths requiring more than one piece shall be joined together by stainless steel or bronze solid couplings. The couplings shall be threaded and keyed, threaded and bolted, or bolted only when one of the pieces is made of tubing and shall be of greater strength than the stem.
5. Gates having a width equal to or greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft. The connection shaft shall be provided with a cover for safety.

6. Rising-stem gates with manual actuators shall be provided with a stop collar to be field adjusted according to the manufacturer's instructions at the time of gate installation to prevent over-closing the gate.
- B. Stem Guides
1. Stem guides shall be fabricated from stainless steel. Stem guides shall be equipped with a UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/R ratio shall not be greater than 200.
 2. Stem guide brackets shall be provided as required to meet the stem design requirements specified in this section and may be mounted on the gate guides or yoke or may be wall mounted. Wall-mounted guides shall provide lateral adjustment between the wall and the guide bracket and between the guide bracket and the guide for field alignment. Guides which are mounted on the gate assembly shall be designed and fabricated to ensure proper alignment. Stem guide assemblies and their anchor bolts shall be designed to maintain the alignment under operating loads. Stem guides shall be equipped with a UHMWPE bushing with maximum diametral clearance of 1/8-inch.
- C. Stem Cover
1. Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear Mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

2.4 LIFTING MECHANISM

- A. Operators of the types listed in the schedule shall be provided by the gate manufacturer.
- B. Electric actuators are specified in Division 26.
- C. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 pounds on the crank, and shall be able to withstand, without damage, an effort of 80 pounds.
- D. Gearboxes shall be provided when required to maintain the operating force below 40 pounds. All bearings and gears shall be totally enclosed in a weather tight housing. Operator housing shall be cast steel or cast iron. The pinion shaft of crank-operated mechanisms shall be supported by roller bearings. The operating shaft shall be fitted with a 2-inch square operating nut and removable crank. The crank shall be fitted with a corrosion-resistant rotating handle. The maximum crank radius shall be 15 inches and the maximum handwheel diameter shall be 24 inches.

2.5 ACCESSIBILITY

- A. Crank or handwheel shall be located 36 inches to 42 inches above the walking surface. When required provide enclosed chain and sprocket drive to lower the actuator.
- B. When crank is not accessible from the walkway provide horizontal extension and supports.
- C. Grease zerks that are not easily accessible shall be extend to an easily accessible location.

2.6 MATERIALS

Part	Material
Slide, Spigot, Frame, Stiffeners, Yoke, Guide angles	Stainless Steel, AISI 304L
Side and Top seals	Ultra High Molecular Weight Polyethylene (UHMWPE), ASTM D4020
Invert seal	Ultra High Molecular Weight Polyethylene (UHMWPE) ASTM D4020
Bearing bars, Guides, Stem guide liner	Ultra-High Molecular Weight Polyethylene (UHMWPE) ASTM D4020
Bottom seal	Ultra-High Molecular Weight Polyethylene (UHMWPE), ASTM D4020
Threaded stem, Stem guides, tandem shafts, extension shafts	Stainless Steel, AISI 304L
Seal retainer	Stainless Steel, AISI 304L
Fasteners	Stainless Steel, ASTM F593/F594, Alloy Group 1
Pedestal/wall bracket	Stainless Steel, AISI 304L or Cast Iron ASTM A126, Class B or Mild Steel, ASTM A36/A36M
Stem cover	Polycarbonate ASTM A-707
Lift and stop nut	Manganese Bronze ASTM B584, UNS-C86500

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify the gates and all appurtenances meet the requirements of these Specifications.

3.2 INSTALLATION

- A. The Contractor shall employ qualified competent personnel for the installation and testing.
- B. Unless otherwise specified, gates shall be installed in accordance with manufacturer's instructions and AWWA C561.
- C. Place concrete so that no voids occur around the frames or thimble, if present.
- D. Securely anchor all materials embedded in concrete. Anchor bolts shall be carefully placed in templates for proper gate alignment. Use epoxied anchor where risk of spalling exists.
- E. Verify that each guide is securely installed, and the gate operates smoothly. After gates have been properly installed, adjusted, and properly lubricated, each slide shall be operated for one complete cycle, open-close-open or close-open-close. Check for proper alignment and for indications of binding throughout a complete cycle. Gates showing excessive leakage shall be removed, remedied, and reinstalled until the excess leakage is no longer present.
- F. Adjust and lubricate gate after installation.
- G. After installation, perform a field leakage test to verify that the gate performs within the allowable leakage requirements of these Specifications.
- H. Touch-up factory coatings damaged during shipping and construction.

3.3 FIELD SERVICE

- A. One trip, one day: Inspection training and leakage testing.

END OF SECTION

SECTION 40 10 00

PROCESS CONTROL & INSTRUMENTATION SYSTEM-GENERAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. General requirements applicable to all process control work.
 - 2. The requirements of this Section apply to all components of the Software Systems unless indicated otherwise.
 - 3. General requirements for programming submittals.
- B. Related sections:
 - 1. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Subcontractors to review all sections to ensure a complete and coordinated project:
 - a. Items involving electrical, control, and instrumentation construction may be shown on Drawings or referred to in Specifications that do not apply specifically to electrical, control and instrumentation systems.
- C. The Programming Contractor under the General Contractor shall design, furnish, and program all RTU's and the SCADA system. The Programming Contractor shall provide all software as specified herein for programming the system. The Programming Contractor and the electrical contractor shall be responsible to test each device and loop to verify proper function of all equipment on the project, whether provided by the contractor or by the owner. They shall then work with the owner to test and commission the entire system as described herein. The programming contractor shall be present to test the I/O for each equipment subsystem. The I/O to the RTU systems shall be tested at this time. The programming contractor shall provide and install a simple testing routine in each RTU in order to verify all I/O is functioning properly. All I/O shall be tested from its respective field device to the software level in the RTU. If final RTU programming is complete at the time of testing, the final software programming shall be used to test each device
- D. The Programming Contractor shall design the operator interface graphics, human machine interface (HMI) graphics, RTU logic, and control systems hardware as specified herein.

E. Contract Documents:

1. General:

- a. Contract documents consist of drawings, specifications, and other documents issued by the ENGINEER. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work, and requirements shown, written or reasonably inferred there from on one is considered as written, shown or implied in all. In the event work is called for in more than one place and there are conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.
- b. Schematic Diagrams:
 - 1) All controls are shown de-energized.
 - a) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.
 - b) Control schematics are to be used as a guide in conjunction with the descriptive operating sequences found in the Drawings or Specifications. Combine all information and furnish a coordinated and fully functional control system program.

1.2 REFERENCES

A. Code Compliance:

1. The publications are referred to in the text by basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of Bid governs
2. The following codes and standards are hereby incorporated into these Specifications:
 - a. National Fire Protection Association (NFPA):
 - 1) NFPA 70 - National Electric Code (NEC).
 - 2) NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 3) NFPA 496 - Purged and Pressurized Enclosures for Electrical Equipment, where applicable.
 - 4) NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
 - b. Underwriters Laboratories, Inc. (UL):
 - 1) UL 508 - Industrial Control Equipment.

- c. American National Standards Institute (ANSI):
 - 1) ANSI B16.5 - Pipe Flanges and Flanged Fittings.
- d. American Petroleum Institute (API):
 - 1) API RP551 - Process Measurement Instrumentation.
 - 2) API RP552 - Transmission Systems.
 - 3) API RP553 - Refinery Control Valves.
 - 4) API RP554 - Process Instrumentation and Control.
 - 5) API RP555 - Process Analyzers.
 - 6) API RP556 - Fired Heaters & Steam Generators.
 - 7) API RP557 - Guide to Advanced Control Systems.
- e. American Society of Testing and Materials (ASTM):
 - 1) ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- f. Instrumentation, Systems, and Automation Society (ISA):
 - 1) ISA-5.1 - Instrumentation Symbols and Identification.
 - 2) ISA-5.2 - Binary Logic Diagrams for Process Operations.
 - 3) ISA-5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.
 - 4) ISA-5.4 - Instrument Loop Diagrams.
 - 5) ISA-5.5 - Graphic Symbols for Process Displays.
 - 6) ANSI/ISA-7.00.01 - Quality Standard for Instrument Air.
 - 7) ISA-RP - 12.4 - Pressurized Enclosures.
 - 8) ANSI/ISA-18.1 - Annunciator Sequences and Specifications.
 - 9) ISA-20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.
 - 10) ISA-TR20.00.01 - Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations Updated with 27 New Specification Forms in 2004-2005.
 - 11) ANSI/ISA-50.00.01 - Compatibility of Analog Signals for Electric Industrial Process Instruments.
 - 12) ISA-51.1 - Process Instrumentation Terminology.
 - 13) ISA-RP60.3 - Human Engineering for Control Centers.

- 14) ISA-71.01 - Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity.
- 15) ISA-71.02 - Environmental Conditions for Process Measurement and Control Systems: Power.
- 16) ISA-71.03 - Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences.
- 17) ISA-71.04 - Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants.

1.3 DEFINITIONS

- A. Definitions of terms and other electrical and instrumentation considerations as set forth in the:
 1. National Electrical Code.
 2. Institute of Electrical and Electronic Engineers.
 3. Instrumentation, Systems, and Automation Society.
 4. National Fire Protection Association.
 5. National Electrical Testing Association.
- B. Specific Definitions:
 1. Control Circuit: Any circuit operating at 120 volts AC or DC or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.
 2. Panel: An instrument support system that may be either a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term "panel" in these Contract Documents is interpreted as a general term, which includes flat surfaces, enclosures, cabinets and consoles.
 3. Power Circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
 4. Signal Circuit: Any circuit operating at less than 50 volts AC or DC, which conveys analog information or digital communications information.
 5. Digital Bus: A communication network, such as Profibus, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions and diagnostic information.

6. 2-Wire Transmitter (Loop Powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Specification, two-wire transmitter refers to a transmitter that provides 4 to 20 mA current regulation of a signal in a series circuit with an external 24 VDC driving potential.
7. Field Bus Communications signal or both.
8. Powered Transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Specification, the produced signal may either be a 4 to 20 mA current signal, a Digital Bus communications signal or both.
9. Modifications: Changing, extending, interfacing to, removing or altering an existing circuit.

C. Acronym Definitions:

1. ES: Enterprise System: Computer based communications or data sharing system utilized for non-process control functions such as E-mail, sharing files, creating documents, etc.
2. FAT: Factory Acceptance Test.
3. HOA: Hand-Off-Auto control function that is totally RTU based. In the Hand mode of control equipment is started or stopped, valves are opened or closed through operator direction under the control of the RTU software. In the Auto mode of control equipment is started or stopped, valves are opened or closed through a control algorithm within the RTU software. In the Off mode the equipment is prohibited from responding from the RTU control.
4. HMI: Human Machine Interface: RTU based operator interface device consisting of an alphanumeric display and operator input devices. The HMI is typically a flat panel type of display with either a touch screen or tactile button interface.
5. HVAC Heating, Ventilation, & Air Conditioning.
6. ICSC: Instrumentation and Control System Contractor: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.
7. IJB: Instrument Junction boxes. A panel designed with cord sets to easily remove, replace or relocate instrument signals.
8. I/O: Input / Output.

9. LCP: Local Control Panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a RTU or RIO.
10. LAN: Local Area Network: A control or communications network that is limited to the physical boundaries of the facility.
11. LOR: Local-Off-Remote control function. In the Remote mode equipment is started or stopped, valves are opened or closed through the RTU based upon the selection of the HOA. In Local control, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the RTU with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.
12. OIT: Operator Interface Terminal. PC based interface device used for operator interface with the SCADA system.
13. P&ID: Process and Instrumentation Diagram.
14. PC: Personal Computer.
15. PCIS: Process Control and Instrumentation System, includes the entire instrumentation system, the entire control system, and all of the work specified in Division 17 and depicted on the Instrumentation Drawings.
16. PCM: Process Control Module: An enclosure containing any of the following devices: RTU, RIO.
17. PJB: Power Junction Box: An enclosure with terminal blocks that distribute power to multiple instruments.
18. RTU: Programmable Logic Controller.
19. RIO: Remote I/O device for the RTU consisting of remote I/O racks, or remote I/O blocks.
20. RTU: Remote Telemetry Unit: A controller typically consisting of a RTU, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
21. SCADA: Supervisory Control and Data Acquisition system consists of the computer-based software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software.
22. UPS Uninterruptible Power Supply.
23. VCP: Vendor Control Panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain RTUs, RIO, OIT, HMI, etc.

24. WAN: Wide Area Network: A control or communications network that extends beyond the physical boundaries of the facility.

1.4 SYSTEM DESCRIPTION

A. General Requirements:

1. The Work includes everything necessary for and incidental to executing and completing the general requirements for programming the control system described in the Contract Drawings and Specifications and reasonably inferable there from including but not limited to:
 - a. Procure all software.
 - b. With the electrical contractor, perform post programming tests on panels.
 - c. With the electrical contractor, oversee, document, and certify system pre-commissioning.
 - d. With the electrical contractor, conduct the Performance Tests.
 - e. Prepare Operation and Maintenance Manuals.
 - f. Conduct training classes.
 - g. Develop all requisite loop descriptions, functional narrative and instructions and record drawings associated with the programs provided under other Divisions of these Specifications.
2. It is the intent of these Specifications that the programmed system be complete and operable.
3. Furnish detailed, complete, and thorough operations and maintenance documentation, including, but not limited to: Operations Manuals, Maintenance Manuals, Training Manuals, As-Built Software Documentation, final as installed software configurations, and software disks including installed program disk.

1.5 SUBMITTALS

A. General:

1. Furnish Submittals that are fully developed for a given section of the work and fully indexed with a tabbed divider for every element and component.

2. Sequentially number the pages within the tabbed sections. Submittals and Operation and Maintenance manuals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
3. Edit all Submittals and Operation and Maintenance Manuals so that the submittal specifically applies to only the equipment furnished. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.
4. Submittal Requirements:
 - a. Submit copies of shop drawings, and product data, in accordance with the requirements of this Section:
 - 1) Show information on software to be supplied, SCADA screens, reports, menus, operation, etc.
5. Exceptions to Specifications and Drawings:
 - a. Include a list of proposed exceptions to the Specifications and Drawings along with a detailed explanation of each.
 - b. Any exceptions to the Specification and Drawings must be noted and the reason for the exception explained.
 - c. If there is insufficient explanation for the deviation, the submittal will be returned requiring Revision and Re-submittal.
 - d. Acceptance of any exception is at the sole discretion of the ENGINEER. Furnish all items (materials, features, functions, performance, etc.) that are not listed as exceptions strictly in accordance with the Specifications and Drawings.
 - e. Replace all items that do not strictly meet the requirements of the Specifications, which were not previously accepted as exceptions, even if the Submittals contained information indicating the failure to meet the requirements.
6. Submittal Organization:
 - a. First page:
 - 1) Specification Section reference.
 - 2) Name and telephone number of individual who reviewed submittal before delivery to ENGINEER.
 - 3) Name and telephone number of individual who is primarily responsible for the development of the submittal.
 - 4) Place for CONTRACTOR's review stamp and comments.

- b. Next pages:
 - 1) Provide confirmation of Specification compliance in a tabular form that individually lists each Specification section, paragraph, and subparagraphs and unequivocally states compliance with said requirement or takes exception to the requirement and lists the reason for said exception and offers alternative means for compliance.
 - 2) Include a response in writing to each of the ENGINEER's comments or questions for submittal packages which are re-submitted:
- c. In the order that the comments or questions were presented throughout the submittal.
- d. Referenced by index section and page number on which the comment appeared.
- e. Acceptable responses to ENGINEER's comments are either:
- f. ENGINEER's comment or change is accepted and appropriate changes are made.
- g. Explain why comment is not accepted or requested change is not made.
- h. Explain how requirement will be satisfied in lieu of comment or change requested by ENGINEER.
- i. Any re-submittal, which does not contain responses to the ENGINEER's previous comments, shall be returned for revision and re-submittal.
- j. No further review by the ENGINEER will be performed until a response for previous comments has been received.
- k. Remaining pages:
 - 1) Actual Submittal data:
 - a) Organize Submittals in exactly the same order as the items are referenced, listed, and/or organized in the Specification section.
 - b) For Submittals that cover multiple devices used in different areas under the same Specification section, the Submittal for the individual devices must list the area where the device is intended to be used.
 - l. Specific Submittal requirements:
 - 1) Furnish the submittals required by each Section or Division 17:
 - a) Product Data.
 - b) Shop Drawings.

m. Furnish submittals in the following general order, each in a separate bound set:

- 1) Product Data.
- 2) After approval of the Product Data, submit the Project Shop Drawing submittals
- 3) Testing, Calibration and Start-up procedures.
- 4) Operation and Maintenance Data.
- 5) Training Submittals.
- 6) Record Documents.

B. Product Data:

1. General:

- a. Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.
- b. Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.
- c. Include:
 - 1) Catalog cuts.
 - 2) Bulletins.
 - 3) Brochures.
 - 4) Quality photocopies of applicable pages from these documents.
 - 5) Identify on the data sheets the project name, applicable specification section, and paragraph.
 - 6) Identify model number and options for the actual equipment being furnished.
- d. Neatly cross out options that do not apply or equipment not intended to be supplied.

2. Software Data Sheets and Cut Sheets:

- a. Provide fully completed data sheets , in hardcopy, for each software package. Including the following information on the data sheet:
 - 1) License limitations, points, screens available.
 - 2) Description of software compatibilities with hardware (RTU's, ethernet communications, P.C.'s, modems, HMI's, etc.)
 - 3) Description of software capabilities, function and use.

3. Software Program Submittal:
 - a. Prepare a program submittal to demonstrate how the programs address the following:
 - 1) Alarm indication and notification.
 - 2) Alarm acknowledgement.
 - 3) Operational sequences.
 - 4) Communications.
 - 5) Recording and trending – show for each recorded or tended tag.
 - 6) Report generation with samples.
 - 7) Maintenance information and notes storage.
 - 8) Samples of each screen shot and report.
- C. Operation and Maintenance Manuals:
 1. Furnish the ENGINEER with a complete preliminary set of written Operation and Maintenance Manuals 2 weeks before start-up and/or testing.
 2. Furnish in accordance with the following additional requirements.
 3. Submit preliminary sets of these manuals to the ENGINEER for review of format and content:
 - a. ENGINEER will return 1 set with comments.
 - b. Revise and/or amended as required and submit the requisite number of copies to the ENGINEER 15 days before Pre-commissioning of the systems.
 4. Incorporate changes that occur during startup and submit as part of the final manuals.
 5. Provide comprehensive information on all systems and components to enable operation, service, maintenance, and repair.
 6. Organize the Operation and Maintenance Manuals for each process in the following manner:
 - a. Section A-Description of operation.
 - b. Section B- Screen shots.
 - c. Section C- Report samples.
 - d. Section D- Trending/recording operations.
 - e. Section E- Software information with disks.
 - f. Section F- Operational Manual.

g. Section G- Spare Parts List.

7. Training Submittals:

- a. Develop and submit for review a General Training Plan. Include complete descriptions of all planned training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools to be used (simulators, self-paced modules, personal computer-based training, etc.).
- b. The ENGINEER will review the General Training Plan. Special emphasis will be placed on review of the qualifications of the proposed instructors and the timing of the individual courses to maximize their effectiveness. If, in the opinion of the ENGINEER, the proposed instructors are not sufficiently qualified to conduct the specified training courses, or lack experience, where required, on the specific configuration of the system provide more qualified instructors.
- c. Training Course Plan submittals:
 - 1) For each training course or other training activity, submit a detailed, complete outline and agenda for each lesson.
 - 2) Describe any student pre-requisites for the course or training activity.
 - 3) Provide an updated schedule for all sessions of the course, including dates, times, durations, and locations.
 - 4) Submit training materials.
- d. Incorporate all submittal review comments into the course.
- e. Do not conduct training courses before review and acceptance of the Course Plan submittal for the course.

D. Responsibilities

1. The Programming Contractor, shall be responsible to the OWNER for the implementation of the software and programmed systems.
2. Instrumentation & Control System Contractor (ICSC) Responsibilities:
 - a. The Programming Contractor shall assume full responsibility to perform all engineering to select, furnish, install, test, calibrate, and place into operation all software for RTU's and SCADA P.C.'s.
 - b. The Programming Contractor shall be responsible for coordination with OWNER to provide a complete, integrated and functional software system.

- c. As a minimum, the Programming Contractor shall perform the following work:
 - 1) Prepare software submittals.
 - 2) Design, develop, and implement controls, screens, reporting, recording, etc.
 - 3) Prepare the test plan, the training plan, and the spare parts submittals.
 - 4) Procure all software.
 - 5) Perform tests on RTU and SCADA software.
 - 6) Participate in system pre-commissioning.
 - 7) Participate in the performance tests.
 - 8) Prepare Technical Manuals.
 - 9) Conduct training classes.

E. Programmer Qualifications:

- 1. The Qualification requirements specified in these paragraphs apply to the portions of the Process Control and Instrumentation System Work to be provided by the Programming Contractor.
- 2. The Programming Contractor shall meet the following minimum qualifications:
 - a. The Programming Contractor shall have completed at least five (5) successfully completed projects for a system of similar scope and complexity in which the Programming Contractor used components the same as those intended for use on this project, performed system programming, documentation, including software configuration and documentation, field testing, calibration and start-up, operator instruction and maintenance training.
 - b. The Programming Contractor company shall be actively involved in the instrumentation, RTU based control systems, and SCADA systems business for a minimum of ten years and has adequate facilities, organization structure, manpower and technical and managerial expertise to properly perform the WORK under and in conformance with these Specifications.

1.6 SEQUENCING

A. General:

- 1. Testing requirements are specified in Division 27.

2. Work restrictions and other scheduling requirements are specified in the General specifications.
- B. Pre-submittal Conferences:
1. Before producing any submittals, schedule a pre-submittal Conference for the purposes of reviewing the entire project, equipment, control philosophy, schedules, and submittal requirements.
- C. Training:
1. Complete all training before the pre-commissioning phase of the project may start.
 2. Schedule the training sessions a minimum of 15 days prior to the start date of the courses.
 3. Submit training manuals to the ENGINEER a minimum of 10 days before starting the training session.
 4. Within 10 days after the completion of each session, submit the following:
 - a. A list of all OWNER personnel that attended the session.
 - b. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.
- D. Performance Testing:
1. Complete Pre-commissioning test a minimum of 5 days before the Performance Test.
 2. Conduct a 90-day Performance Test.

1.7 WARRANTY

- A. Warrant the Software and Programming in accordance with the General Conditions:
1. Provide additional warranty as specified in the individual Division 17 Specifications.

1.8 SYSTEM STARTUP

- A. Replace or modify software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:
1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the ENGINEER.

1.9 MAINTENANCE

- A. Before Substantial Completion, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Training:
 - 1. General:
 - a. Provide system maintenance and operator training courses for all the instrumentation and control systems furnished.
 - b. Conduct all training at the Project Site unless another location is approved by the ENGINEER and OWNER.
 - 1) Include instruction on the use of all maintenance equipment and special tools provided under the contract.
 - c. Tailor training classes to the specific needs of the class participants:
 - 1) The specific categories and number of personnel in each category are identified below.
 - 2) Furnish training courses that are a combination of classroom and hands-on training:
 - 3) Present the minimum number of sessions, specified in Table 1, for each course in order to satisfy class size restrictions and limitations scheduling OWNER staff.
 - 4) Furnish additional sessions if required to accommodate the total number of personnel identified for each course.
 - 5) Schedule individual training classes with the OWNER at least 3 weeks before the start of the class.
 - 6) Schedule all training classes Monday - Friday between 7:30 AM and 3:30 PM.
 - 7) Each individual daily training session, travel time excluded:
 - a) Minimum duration of 4 hours.

- b) Maximum duration of 7 hours.
- c) Breaks scheduled at least every 90 minutes and 1 hour for lunch.
- 8) Complete training for maintenance personnel 90-days before Performance Testing.
- 9) Complete operator training classes before startup of the SCADA system, or any part of it:
- 10) Refer to Paragraph 1.09 of this Section.
- 11) Schedule follow-up training classes after SCADA startup on a schedule determined by the OWNER.
 - a) Furnish highly qualified training instructors for technical training with demonstrated expertise in not only control system functionality but also professional training techniques:
 - b) Provide completion reports in accordance with Paragraph 1.09 of this Section.

2. Training Manuals and Materials:

- a. Furnish training manuals and other materials for training courses.
- b. Manuals are to be professionally written to present the course material in a format that is easy to comprehend.
- c. The manuals are to serve as teaching aids during presentation of the training classes.
- d. Manuals are to serve as reference material after the training has been completed.

Table 1			
Course Title	Minimum Course Length (days per session)	Personnel (Estimated Number of Students)	Minimum Number of Sessions
SCADA, HMI, RTU Software	1	5	1

3. Training Course Requirements:

- a. Software Training:
 - 1) Furnish training on software and on related systems, including operation alarms, control, recording, reporting, etc.

- 2) Furnish training on features, operation, troubleshooting, and maintenance.
- b. HMI Training:
- 1) Provide the following:
 - a) Overview of firmware, including starting, stopping, and RTU interface.
 - b) Troubleshooting.
- c. Follow-up Training:
- 1) Provide on-site follow-up training class beginning after startup of the SCADA system. The intent for these classes is to provide the OWNER's personnel the opportunity for a review and "refresher" of the training topics and material after they have had some experience using the system.
 - 2) Mutually schedule and develop the content of these classes with the OWNER no later than 1 month before the beginning of the first session:
 - a) Schedule at the OWNER's discretion on non-consecutive days spaced out over the start-up and warranty period.

END OF SECTION

**SECTION 40 15 10
PROCESS CONTROL STRATEGIES**

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. This section includes the process control strategies for this Contract. Together with the process input/output schedule, the equipment specifications (including control strategies for local equipment control panels), and the Drawings, the process control strategies describe the required operation, monitoring, and control of the facilities included in this Contract. The Contractor shall provide all equipment, and services necessary to implement all functions described herein.
- B. The Contractor shall be responsible for furnishing functioning systems as described herein. The functional descriptions contain requirements for furnishing and installing labor and materials that may not appear elsewhere in the contract documents.

1.2 GENERAL DESIGN INFORMATION

- A. Indicator lights on all MCCs, control panels, starter enclosures, interfaces, etc. shall conform to the following color convention:

Condition	Color
Running/Open	Green
Auto	White
Ready / Stopped / Off / Closed	Red
Fail	Red
Alarm	Red
Generic Status	Green, Blue or White

- B. Running status shall be provided from auxiliary contacts provided with the motor starter. Auto status shall be defined as HOA or OA switch in Auto position. Ready status shall be defined as in remote or auto mode with all interlocks satisfied (no failure conditions present). Stopped and Off status shall be defined as all interlocks satisfied (no failure conditions present), except for no remote or auto mode. Failed status shall be defined as motor overload and/or any other shutdown mode such as over torque, over temperature, low oil pressure, high vibration, etc.

- C. A discrepancy failure shall be indicated through the control system for any drive, motor, instrument, etc. that should be running or providing a reading but for which the PLC is not receiving a run status signal or valid reading. An example is a motor which is commanded to run by the control system but is not subsequently detected as running. An adjustable time delay shall be provided for each motor to allow time for the motor to start and satisfy all interlocks.
- D. Manual start/stop, open/close, speed/position adjustment, etc., from the Operator work stations shall be provided for all equipment controlled by the control system.
- E. Where devices such as temperature, moisture, and/or vibration sensors, over- or under-pressure protection, space heaters, etc. are provided with process equipment and their associated motors under the various sections of Division 11, the Contractor shall provided all required interconnecting wiring between those devices and their associated MCCs, motor starters, VFDs, local control panels, etc.
- F. Where setpoints, operating limits, and other control settings are provided by the process control strategies, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable, and based on actual operating conditions, the Contractor shall make all necessary adjustments to provide smooth, stable operation.
- G. The control system shall be capable of receiving inputs of initial run-times for existing and proposed equipment. Initial run-time shall not automatically assumed to be zero.
- H. All PLC control strategies shall return to a normal control mode upon restoration of power.
- I. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the integral and derivative functions to zero. All PLC-controlled variable speed equipment shall be provided with individual speed control PID modules in the PLC which shall be cascaded with the overall setpoint PID modules as required. All setpoints, sequence timers, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the Operator work stations.
- J. All setpoints, alarms, etc. based upon an analog input signal or field variable shall be provided with time delays and dead bands to prevent nuisance tripping of controls and alarms.
- K. Elapsed run time shall be determined through an auxiliary contact on the starter which is an input to the PLC.
 - 1. Elapsed run time shall be displayed at the SCADA level for each and every motor

controlled through the PLC system.

2. Individual elapsed run time accumulation may be reset by the operator after entering a password if the proper security level is associated with said password.
 3. Elapsed run time shall be displayed as 99,999.9 hours after which the elapsed run time registers shall recycle to 0.0 hours.
 4. Provisions shall be made to allow the operator to enter a start value for runtime accumulation.
 5. Elapsed run time shall be accumulated and stored in PLC registers and not in the SCADA system.
- L. PID control algorithms.
1. PID control algorithms shall have operator selectable slew rates for setpoints that will allow the setpoint to slowly ramp to its final value in order to minimize system disturbance.
 - a. Individual setpoint slew rates shall be set at a local HMI if available as well as through the SCADA system.
 2. Each PID control algorithm shall have a face plate associated with the individual PID control algorithm that shall be displayed at its associated HMI and at the SCADA terminal. Said face plate shall have the following functions:
 - a. Display Output, CV.
 - b. Display Setpoint, SP.
 - c. Display Process Variable, PV.
 - d. Allow for operator selection of Automatic or Manual control of Output.
 - e. Under manual control of output allow the Operator to enter the desired output value.
 - f. Allow for input of the three PID tuning parameters.
- M. Programmable settling and proving timers shall be provided in all control sequences for starting and stopping of pumps, in order to let the process settle down before proceeding with any additional control functions.
1. These timers shall be imbedded in the PLC logic, tuned in the field, and listed separately as part of the software submittal and O & M manual.
- N. Status indication:
1. The associated pilot light, HMI display, and SCADA display for each valve and

pump shall indicate valve or slide gate position if available by constantly illuminating the corresponding status indication and report this condition to the SCADA system.

2. As previously described a fault condition shall flash the associated status indicator and alarm within the SCADA system.
3. When a valve is in transition, not fully closed and not fully opened, then the valve open and valve closed status indicator shall:
 - a. For HMI and graphic displays state that the valve is in transition.
 - b. For pilot lights shall alternately flash on and off the valve fully opened and fully closed pilot lights.
- O. When setpoints or actions are identified to occur on more than one HMI, or both the HMIs and SCADA, the last action or setpoint shall override the current condition, unless otherwise noted.
- P. Control software and/or hardware shall be so configured and designed as to monitor for loss of analog signal (signal <4 mA), analog signal too large (signal > 20 mA), or rate of signal change too fast (individual rate parameter for each analog input signal to be imbedded in software), when any of these conditions are detected the control system shall alarm this condition, and close the appropriate valve and or stop the appropriate motor in order to prevent the process from running away.
- Q. The manual control mode shall be completely manual and under the operator control, there shall be no programmed interlocks requiring completion of a previous step before operating a device, unless specifically identified in the individual loop descriptions as occurring in the manual mode.
- R. Number of starts shall be accumulated for each motor.
 1. The number of starts for the current day shall be moved into a register and held as the previous day's number of starts at 0:01 hours each day.
 2. The number of starts for the current day shall be entered into the historical data base time and date stamped at 0:01 hours each day.
 3. The current day number of starts shall be reset at 0:01 hours each day.
- S. Alarm/Fault Indication/Acknowledgement
 1. Furnish an alarm acknowledgement pushbutton at each VCP, HMI, or LCP that shall signal the PLC that an alarm or fail condition has been acknowledged. This device shall only affect the alarms that are present on the panel where the device is located.
 2. In general any fault condition shall flash the appropriate pilot light and/or

graphic at a rate of on for 0.5 seconds and then off for 0.5 seconds.

3. The individual alarm acknowledgement pushbutton or action shall function as follows:
 - a. Shall change the flashing alarm indication to continuously ON if the alarm or fail condition persists after the acknowledgement button or action has been depressed.
 - b. Shall turn OFF the alarm indication if the alarm or fail condition has been corrected and the alarming system has returned to normal.
4. An alarm beacon and horn shall be located as needed.
 - a. The alarm silence pushbutton or HMI command shall silence the horn but continue to show the visual alarm.
5. All alarm and fail conditions shall flash their respective pilot lights, indicators, HMI, or SCADA graphics, until the condition is acknowledged by the operator.
 - a. Once the operator acknowledges the alarm or fail condition the pilot light, indicator, HMI, or SCADA graphic shall remain ON in a steady condition.
 - b. Once the alarm has been cleared and the operator again acknowledges the alarm or fail condition the pilot light, indicator, HMI, or SCADA graphic shall turn OFF.
6. All valves, pumps, motors, and other process equipment shall have fail alarms displayed and reported at the HMI and SCADA level.

T. Tank and vessel levels.

1. All tank and vessels levels shall be displayed both in feet (XX.XX) and gallons, whether or not specifically identified in the P & IDs or Loop descriptions.
2. All identified tanks and/or vessels that have a level measurement shall include, whether or not identified, the following minimum functions that shall be displayed on the associated HMI and SCADA System.
 - a. Numerical readout of process material level in the tank.
 - b. Setpoint for high level and high level alarm
 - c. Setpoint for low level and low level alarm.
 - d. Setpoints for high level and low level shall be entered as a level or volume as directed by the ENGINEER.

U. Power failure.

1. The control system upon sensing a power failure shall store, within, the PLC memory the current accumulation of all time records and flow totals and as necessary, the status of all devices, i.e. ON or OFF, to allow a return to normal operating condition.

V. PLC System Status

1. There shall be a minimum of one screen that shall include the status of all PLCs in the system and the status of the PLC communications LAN.
2. The PLC shall monitor communications status with equipment including with heartbeat status and alarm on communications failure.

W. Analog device calibration override.

1. Provide a SCADA screen for each and every analog input that allows the Operator to access said analog input to:
 - a. Disable the analog input in the PLC control system.
 - b. Enter a value for the analog input from the SCADA system to the PLC.
 - c. Hold the last analog input value while the actual analog input is disabled.
2. Provide a SCADA screen for each and every analog output that allows the Operator to access said analog input to:
 - a. Force an output value entered from the SCADA system to the PLC.
 - b. Hold the last analog output value while the programmed output is disabled.

PART 2 - PRODUCTS

2.1 CONTROL DESCRIPTION

2.2 ADDITIONAL I/O ALARMS AND CONTROLS

- A. PLC I/O, Control, and Alarms:
1. DI E-STOP Engaged: Alarm and locked shutdown AUTO or not. Also all outputs go to safe state AUTO or not.
 2. DI PLC Reset DI: Master Reset button input from control panel. Locked-out shutdowns release. This does not reset the PLC or counters or timers or totalizers.
 3. DI PLC Power Fail: Relay drops power when PLC Cabinet loses primary power. Secondary power (UPS) continues. Alarm AUTO or not.
 4. AI Level: Indicator and data for control panel.
 5. DI Pump Rm Flood: Alarm AUTO or not.

6. AI Screen Room Temperature: Information and data to HMI. Alarm on high/low temperature. High > 40 deg C (104 deg F). Low < 5 deg C (40 deg F).
7. DI Intrusion Alarm: Alarm on intrusion.

END OF SECTION

SECTION 40 20 00
INSTRUMENTS GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in operation process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with all instrumentation, panels, controls, and process equipment control panels with the process control system as shown on the Drawings and as specified. Mounting of associated transmitters, indicators, power supplies, brackets, and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of this Specification and the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of the process instrumentation on process lines shall be provided under this Contract.
- C. Taps and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. It is the Contractor's responsibility to ensure that the location, supports, orientation, and dimensions of the connections and taps for instrumentation as such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 10 00 – Process Control and Instrumentation Systems
- B. Division 26.

1.3 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. 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
API RP550	Manual on Installation of Refinery Instruments and Control Systems, Part I – Sections 1 Through 13
ISA S20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology

1.4 GENERAL INFORMATION AND DESCRIPTION

- A. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery, and complete installation and field testing of all instruments and appurtenances whether specifically mentioned in the Specification or not.
- B. The instruments shall be furnished and installed with all necessary accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. The installations shall incorporate the highest standards for the type of service shown on the Drawings including loop testing of the entire installation and instruction of operating personnel in the care, operation, calibration, and maintenance of all instrumentation.
- C. All instrumentation shall be of first class workmanship and shall be entirely designed and

suitable for the intended services. All materials used in fabricating the equipment shall be new and undamaged.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, all instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.
- B. Equipment installed in hazardous areas shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electric Code.
- C. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- D. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in paragraph 3.1.B. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable, except for speed and valve position. Floating outputs shall be provided for all transmitters.
- E. Unless otherwise specified, field instrument and power supply enclosures in corrosive environments shall be 316 stainless steel, fiberglass, or PVC coated copper free cast aluminum NEMA 4X construction.
- F. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
- G. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture, and fungus. Solid-state components shall be conservatively rated for long term performance and dependability over ambient atmospheric fluctuations. Ambient conditions shall be -15 to 50 degrees C and 10 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- H. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.
- I. All non-loop powered instruments and equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with

the above shall be provided. Where equipment requires voltage reduction, constant voltage transformers shall be supplied.

- J. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- K. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials is available.

2.2 ACCESSORIES

- A. Isolation Valves – Valves shall be full port ball valves with ASTM A276, Type 316 stainless steel trim and body and with Teflon seats and packing. Valves shall be Parker CPI, Whitey, Hoke, or equal.
- B. Gage Valves – Gage valves shall be machined from ASTM A276 bar stock and shall be provided with 1/2-inch NPT connections and integral bleed valve. Valves shall be Anderson, Greenwood & Company M9530, Hoke 6801L8Y, or equal.
- C. Root Valves – Root valves shall be ASTM A276, Type 316 stainless steel bar stock with 1/2-inch NPT male process connection and three 1/2-inch NPT female instrument connections. One instrument connection shall be provided with an ASTM A276, Type 316 stainless steel bleed valve. ASTM A276, Type 316 stainless steel plugs shall be provided for unused ports. Lagging type units shall be provided for insulated vessels and pipes. Root valves shall be Anderson, Greenwood & Company M5 AVS-44, Hoke 6802L8Y, or equal.
- D. Manifolds – Manifolds shall be three-valve bar-stock type. Manifold body shall be machined from 316 stainless steel bar stock. Valves shall be globe configuration with 316 stainless steel ball seats and Teflon stem packing. Manifolds shall be designed for direct mounting to differential pressure transmitters in place of the flanges normally furnished. Fabricated manifolds or manifolds employing needle or soft seat valves are not acceptable. Purge taps, 1/8-inch NPT shall be furnished on manifolds where water purge is specified. Manifolds shall be Anderson Greenwood M4TVS, Hoke 8123F8Y, or equal.
- E. Tubing – Instrument tubing between the process connection and instruments shall be 1/2-inch x 0.065-inch seamless annealed ASTM A269, Type 316 stainless steel. Tubing fittings shall be Type 316 stainless steel. Fittings shall be of the swage ferrule design and shall have components (nut, body and ferrule system) interchangeable with those of at least one other manufacturer. Flare and ball sleeve compression type are not acceptable. Fittings shall be Parker CPI, Crawford Swagelok, Hoke Gyrolok, or equal.
- F. Chemical Seals
 - 1. Diaphragm – Seal shall be the diaphragm type with flushing connection, Type 316 stainless steel body and Type 316L diaphragm unless otherwise specified. Seal shall be Mansfield and Green Type SG, Ashcroft Type 101, or equal.
 - 2. Annular Ring – Seal shall be the in-line full stream captive sensing liquid type. Metallic wetted parts shall be Type 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated 200 psig with not more than 5-inch WC

hysteresis. Seals shall be Ronningen-Petter Iso-Ring, Red Valve series 40, or equal.

3. Fill Fluid – Chemical seals and associated instruments shall be factory filled as follows: Instrument side of seal, capillary tubing, and instrument shall be evacuated to an absolute pressure of 1.0 Torr or less; filled; and sealed. Unless otherwise specified, fill fluid shall be silicone oil, Dow Corning DC200, Syltherm 800, or equal.
- G. Bushings and Thermowells – Bushings or thermowells shall comply with SAMA PMC17-10. Temperature taps shall be 1/2-inch NPT, and lagging extensions shall be provided on insulated vessels or pipes. Thermowells and bushings shall be machined from Type 316 stainless steel bar stock unless otherwise specified.
- H. Purge Assemblies
1. Air – Air purge assembly shall consist of a constant-differential relay, needle valve, check valve and 0.2 to 2.0 scfh rotameter. Assembly shall be Moore Products 62VA, Fischer & Porter 10A3137N-3BR2110, or equal.
 2. Water – Water purge assembly shall consist of a strainer, constant-differential regulator, needle valve, check valve, and 20 to 200 cc/m rotameter. Assembly shall be Moore Products 63BD4A, Fischer & Porter 10A3137N-53BR2110, or equal. Strainer shall be 155 micron wye-type, ASCO 8600A2, Crane, or equal.

2.3 POWERED INSTRUMENTS GENERAL REQUIREMENTS

- A. Powered instruments are those instruments which require power (120 VAC or 24 VDC loop power) to operate. Each instrument includes an element or analyzer and a transmitter/controller.
- B. Transmitters shall be 4 to 20 milliampere output two-wire type with operating power derived from the transmission circuit. Transmitter shall support an external load of 0 to 600 ohms or greater without requiring trimming resistors with a transmission circuit power supply of 24 volts. Transmitter output shall be galvanically isolated from the process and the transmitter case. Time constant of transmitters used for flow or pressure measurement, including level transmitters used for flow measurement, shall be adjustable from 0.5 to 5.0 seconds. Transmitter output shall increase with increasing measurement except where "reverse action" is specified in the instrument schedule.
- C. Electrical parts of transmitter and/or primary element mechanisms shall, as a minimum be housed in enclosures meeting NEMA 250, Type 4 requirements. Where electrical mechanisms are located outdoors or in areas specified as corrosive, enclosures shall meet NEMA 250, Type 4X requirements.
- D. Transmitters located outdoors shall be provided with surge protectors: Rosemount Model 470A, Taylor 1020FP, or equal.
- E. Where two-wire transmitter is located in an area classified as hazardous, it shall be made safe by means of an intrinsic safety barrier. Intrinsic safety barriers for two-wire transmitters shall be of the active, isolating, loop powered type. Barrier shall be Measurement Technology LTD. type MT3042, Stahl 9005/01-252/100/00, or equal.

- F. Where four-wire transmitters are permitted, they shall be provided with a loop powered signal current isolator connected in the output signal circuit. Isolator shall provide galvanic isolation of milliampere transmission signals from transmitters with inadequately isolated output circuits. Isolator shall be housed in a NEMA 250, type 4/7 conduit body and shall derive its operating power from the signal input circuit. Input and output signals shall be 4 to 20 milliamperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms. Isolator shall be Moore Industries SCX/4-20MA/ 4-20/MA/6.5DC/-RF(EX).

2.4 PROCESS SWITCHES GENERAL REQUIREMENTS

- A. Contact outputs used for alarm actuation shall be ordinarily closed and shall open to initiate the alarm. Contact outputs used to control equipment shall be ordinarily open and shall close to start the equipment. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and designed for switching currents from 20 to 100 mA at 24 volts DC. Contacts monitored by electromagnetic devices such as mechanical relays shall be rated NEMA ICS 2, designation B300. Double barriers shall be provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures. Switch electrical enclosures shall be rated NEMA 250, type 4 minimum. Contacts in Class 1, Division 1 areas and monitored by solid-state circuits shall be made safe by suitable intrinsic safety barriers as specified in Section 26 09 13.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General – Equipment shall be located so that it is accessible for operation and maintenance. Electrical work shall be performed in compliance with all applicable local codes and practices. Where these specifications and the Drawings do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.
- B. Equipment Mounting and Support
 1. Field equipment shall be wall mounted or mounted on two-inch diameter aluminum pipe stands welded to a 10-inch square, ½-inch thick aluminum steel baseplate. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than ½-inch by use of phenolic spacers. Expansion shields in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
 2. Embedded pipe supports and sleeves shall be schedule 40, 304 stainless steel pipe, with stainless steel blind flange for equipment mounting as shown on the Drawings.
 3. Materials for miscellaneous mounting brackets and supports shall be 304 stainless steel.
 4. Pipe stands, mounting brackets, and supports shall comply with the requirements of Division 5.

5. Where transmitters are supported from process piping, leveling saddles shall be provided. Transmitters shall be oriented such that output indicators are readily visible.
- C. Control and Signal Wiring – Electrical, control, and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits pass from classified to unclassified areas.

3.2 CLEANING AND ADJUSTMENT

A. General

1. The Contractor shall comply with the requirements of Division 1 and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserve the right to witness any test, inspection, calibration, or start-up activity. Acceptance by the Engineer of any plan, report, or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.
2. The Contractor shall provide the services of factory trained technicians, tools, and equipment to field calibrate, test, inspect, and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provided all personnel, equipment, and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

B. Field Instrument Calibration Requirements

1. Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracies as set forth by the National Bureau of Standards.
2. The Contractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures, name of person performing the calibration, listing of published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required, and corrections made.

3. If doubt exists as to the correct method for calibrating or checking calibration of an instrument, the manufacturer's recommendations shall be used as an acceptable standard, subject to approval of the Engineer.
4. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices being subjected to overvoltages, incorrect voltages, overpressures, or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.
5. Upon completion of instrumentation installation, the Contractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

END OF SECTION

SECTION 40 71 00
CONTROL SYSTEMS – PANELS, ENCLOSURES AND COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for:

1. Design, fabrication and assembly requirements for all instrumentation enclosures, control panels and components provided under this contract, including but not limited to:
 - a. Custom built instrumentation and control panels, including PCMs, RTUs, LCPs, Instrument Junction boxes (IJBs) and power junction boxes (PJBs) etc.
 - b. Control panels furnished as part of equipment systems specified in other Divisions, such as vendor control panels (VCP) and chemical feed panels.
 - c. Control components.
 - d. Control panel fabrication and installation.

B. Related Sections:

1. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Subcontractors to review all sections to ensure a complete and coordinated project.

1.2 REFERENCES

A. Specific References:

1. National Electrical Code (NEC): NFPA 70.
2. National Electrical Manufacturer's Association (NEMA):
 - a. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. NEMA ICS 6 - Enclosures for Industrial Control and Systems.
3. Underwriters Laboratories Inc. (UL):
 - a. UL 50 - Enclosures for Electrical Equipment.
 - b. UL 508 - Industrial Control Equipment.
 - c. UL 508A - Standard for Industrial Control Panels.

1.3 DEFINITIONS

A. Specific Definitions:

1. The term "panel" in this Section is interchangeable with the term "enclosure."

1.4 SYSTEM DESCRIPTION

- A. Provide enclosures suitable for the location and environmental conditions in which they are located, unless otherwise indicated.
- B. Panel Dimensions:
 - 1. Minimum dimensions are scalable from or as indicated on the Drawings and are based upon manufacturer's non-certified information. It is the responsibility of the Contractor or Manufacturer to design and size all panels:
 - a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.
 - b. Panel sizes that substantially deviate (± 3 inches in any dimension) from the sizes shown on the Drawings must be approved by the ENGINEER.
 - c. Maximum panel depth: 30 inches, unless otherwise indicated.
- C. Structural Design:
 - 1. Completed and installed panel work shall safely withstand seismic requirements specified in Section 26 05 00. Enclosures and internal equipment shall be braced to prevent damage from specified forces.

1.5 SUBMITTALS

- A. Provide submittals in accordance with Sections 40 10 00 and 40 20 00.
- B. Provide a two-phase control panel hardware submittal, for each control panel and enclosure being provided on this project, including but not limited to:
 - 1. Product Data:
 - a. Enclosure construction details and NEMA type.
 - b. Manufacturer's literature and specification data sheets for each type of basic material to be installed within or on the panel or enclosure.
 - 2. Shop Drawings:
 - a. Scaled, detailed exterior panel (front and side views) and interior panel layout showing equipment arrangement and dimensional information:
 - 1) Provide draft for review and approval of ENGINEER. The ENGINEER has the authority to substantially alter initial panel layouts.
 - b. Complete nameplate engraving schedule.
 - c. Structural details of fabricated panels.
 - 3. Calculations – Seismic considerations
 - a. Provide installation details based on calculated shear and tension forces:
 - 1) Calculations shall be signed and sealed by a Professional Engineer licensed in the state where the cabinets and panels will be installed.

- b. For assembled enclosures and other equipment with a weight of 200 pounds or more, provide calculations for:
 - 1) Weight including panel internal components.
 - 2) Seismic forces and overturning moments.
 - 3) Shear and tension forces in connections.
 - 4. Calculations – Heat Release
 - a. Cooling Calculations, to include but not limited to:
 - 1) Highest expected ambient temperature for the enclosure's location
 - 2) Internal heat load:
 - 3) Exposure to direct sunlight.
 - 4) Dimensions of the enclosure in inches.
 - 5) Maximum desired temperature inside the enclosure.
- C. Phase I shall be the Control Panel Hardware submittal which shall include but not be limited to:
 - 1. Enclosure construction details and NEMA type.
 - 2. Finish, including color chart for ENGINEER selection of color.
 - 3. Layout.
 - 4. Power circuits.
 - 5. Signal and safety grounding circuits.
 - 6. Fuses.
 - 7. Circuit breakers.
 - 8. Signal circuits.
 - 9. Internally mounted instrumentation.
 - 10. Face plate mounted instrumentation components.
 - 11. Internal panel arrangements.
 - 12. External panel arrangements.
 - 13. Construction drawings drawn to scale which define and quantity.
 - 14. The type and gage of fabrication steel to be used for panel fabrication.
 - 15. The ASTM grade to be used for structural shapes and straps.
 - 16. Panel door locks and hinge mechanisms.
 - 17. Type bolts and bolt locations for section joining and anchoring.
 - 18. Details on the utilization of “UNISTRUT” and proposed locations.
 - 19. Stiffener materials and locations.
 - 20. Electrical terminal box and outlet locations.
 - 21. Electrical access locations.
 - 22. Print pocket locations.
 - 23. Writing board locations.
 - 24. Lifting lug material and locations.
 - 25. Physical arrangement drawing drawn to scale which define and quantity the physical groupings comprising:
 - 26. Control panel sections.

27. Auxiliary panels.
 28. Subpanels.
 29. Racks.
 30. Cutout locations with nameplate identifications shall be provided.
 31. A bill of material which enumerates all devices associated with the control panel.
- D. Phase II shall be the Control Panel Wiring Diagram submittal which shall include but not be limited to:
1. Schematic/Elementary diagrams shall depict all control devices and circuits and their functions.
 2. Wiring/Connection diagrams shall locate and identify:
 3. Electrical devices.
 4. Terminals.
 5. Interconnecting wiring.
 6. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
 7. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment.
 8. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.
 9. Control sequence diagrams shall be submitted to portray the contact positions or connections required to be made for each successive step of the control action.
- E. Testing plans, forms, procedures, and other testing submittals.

1.6 QUALITY ASSURANCE

- A. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by Underwriters Laboratories to assemble and certify UL-labeled control panels:
1. Provide all components and equipment with UL508 listing.
 2. All control panels shall be UL 508A labeled, unless the equipment in the panel and the design in the contract documents cannot be reasonably modified to meet the requirements for UL508A labeling.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Crate all panels for shipment using a heavy framework and skids:
1. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit.

2. Provide suitable shipping stops and cushioning material for all instruments shipped with the panel to prevent damage due to mechanical shock during shipment.
3. Provide each separate panel unit with removable lifting lugs to facilitate handling.

B. Ship all panels by dedicated air ride van, unless otherwise specified or approved.

1.8 PROJECT OR SITE CONDITIONS

A. Environmental Suitability:

1. Provide all control panels and instrument enclosures that are suitable for operation in the site conditions associated with the locations designated in the Contract Documents or as indicated on the Drawings including, but not limited to, material compatibility, site altitude, site seismic, ambient temperature, and humidity conditions.
2. Intrinsically safe.

1.9 SEQUENCING

A. Sequence and schedule in accordance with Section 26 05 00 and accepted progress schedule submitted in accordance with Section 01 31 00.

1.10 WARRANTY

A. Refer to Section 26 05 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. As listed below in the individual component paragraphs.
- B. Provide instruments and other components performing similar functions of the same type, model, or class, and from one Manufacturer.

2.2 MATERIALS

- A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:
 1. Enclosures shall have the following properties:
 - a. NEMA 1: Steel.
 - b. NEMA 4: With gasketed door, rain-tight.
 - 1) Outdoor: Stainless steel.

- 2) Indoor: Stainless steel.
- c. NEMA 4X: With gasketed door, rain-tight.
 - 3) Outdoor: Stainless steel.
 - 4) Indoor: Stainless steel.
- d. NEMA 12: Polycarbonate or fiberglass reinforced polyester (FRP) with gasketed door, dust-tight.
- e. NEMA 7: Cast aluminum.

B. Bolting Material:

- 1. Commercial quality 1/2-inch diameter, plated carbon steel hex-head grade 5 bolts, nuts and washers, with unified coarse (UNC) threads.
- 2. Carriage bolts shall be used for attaching end plates.
- 3. All other bolted joints shall have S.A.E. standard lock washers.

2.3 MANUFACTURED UNITS

A. Panels/Enclosures:

- 1. Manufacturers:
 - a. One of the following:
 - 1) Rittal.
 - 2) Hoffman Engineering.
 - 3) Saginaw Control & Engineering.
- 2. Panel assembly:
 - a. General guidelines for panel fabrication include:
 - 1) Continuous welds ground smooth.
 - 2) Exposed surfaces free of burrs and sharp edges.
 - 3) Base formed of heavy channel iron, either galvanized or powder coated, minimum 1/2 inch holes at 12 inch spacing to accommodate anchoring of freestanding enclosures to floor.
 - b. Construct enclosure and mounting panel using stretcher level sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

Enclosure Height (inches)	Minimum Enclosure Steel Thickness (gauge)	Minimum Back Mounting Panel Thickness (gauge)
Up to 57	12	12
57 - 69	12	10

69 - 82	12, except 10 on back	10
82 or more	10	10

- 1) Use heavier sheet metal to meet seismic requirements specified in Section 26 05 00 or, when required due to equipment requirements.
- c. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient tensional rigidity to resist the bending moments applied via the enclosure surface when it is deflected.
- d. Provide stiffeners for back mounting panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.
- e. Doors construction:
 - 1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.
 - 2) Sufficient width to permit door opening without interference with rear projection of flush mounted instruments.
 - 3) Heavy gauge, piano type, continuous stainless steel hinges.
 - 4) Oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
 - 5) Gasket installed to seal against roll lip on the enclosure opening.
- f. Latches:
 - 1) For panels, other than large types NEMA 4 and 4X, each door provided with a 3-point latching mechanism and padlocking handle with rollers on the ends of the latch rods. Latch rods connected to a common door handle, hold doors securely, forming a compressed seal between door and gasket, at the top, side, and bottom.
 - 2) Include an oil-tight key-locking, 3-point latching mechanism on each door:
 - a) Provide 2 keys per panel.
 - b) All locks keyed the same.
 - 3) For large type NEMA 4 and NEMA 4X cabinets, not available with 3-point latching hardware, provide multiple clips and padlock hasps.
- g. Panel cut-outs:
 - 1) Cut, punch, or drill cut-outs for instruments, devices, and windows. Smoothly finish with rounded edges.
 - 2) Allow a minimum of 3 inch envelope around all devices.
 - 3) Reinforce around cut-outs with steel angles or flat bars for the following:
 - a) Large panel cutouts; for example, openings for local operator interfaces.
 - b) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal.
3. In addition to the requirements specified above, the following requirements for NEMA 4X stainless steel enclosures apply:

- a. Minimum 14 gauge stainless steel.
 - b. Captive stainless steel cover screws threaded into sealed wells.
 - c. Finish: Unpainted, brushed finish.
 - d. Specifically designed for use with flange-mounted disconnect handles where required or as indicated on the Drawings.
4. In addition to the requirements specified above the following requirements for NEMA 4X non-metallic enclosures apply:
- a. Fiberglass construction.
 - b. 10-gauge plate steel reinforcing on the sides, top, and bottom.
 - c. All seams sealed.
 - d. Fiberglass hinges with no exposed metal parts.
 - e. Captivate stainless steel door screws.
 - f. Provisions for internal, sidewall, mounting panels either by welded channels to the interior, or by welded collar studs.
 - g. Provide aluminum mounting panels.
 - h. Non-metallic enclosures are not an acceptable substitute for stainless steel unless indicated on the Drawings.
5. Outdoor Panels. Supplementary requirements for panels located outdoors are as follows:
- a. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.
 - b. Finish: Other than stainless steel and fiberglass, the finish shall be outdoor-rated, baked powder coated over dip-coated primer.
 - c. Door hardware: stainless steel.
 - d. Bases: Heavy channel, gasketed iron bases, flanges up, for anchoring to pad.
 - e. Provide rain canopy and sun shield.
6. Arrangement of Components:
- a. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.
 - b. Arrange panel instruments and control devices in a logical configuration associating pushbutton and selector switches with related readout devices, or as indicated on the Drawings.
 - c. Mount internal control components on an internal back-panel. Devices may be mounted on the side-panel only by special permission from the ENGINEER.
 - d. Group cables, and firmly support wiring to the panel. Provide minimum 8 inches clearance between terminal strips or wiring duct and the base of the enclosure for conduit and wiring space.
 - e. All control panel mounted operator interface devices shall be mounted between 3 feet and 6 feet above finished floor.
7. Grounding:
- a. Provide the following equipment grounding system:

- 1) Equipment grounding conductors and equipment bonding jumpers.
 - 2) Equipment grounding conductor terminals.
 - 3) Conductive structural parts of the enclosure.
 - b. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.
 - c. Size ground wires in accordance with NEC and UL Standards, unless noted otherwise.
 - d. Provide equipment ground bus with lugs for connection of all equipment grounding wires.
 - e. Connect all exposed, noncurrent-carrying conductive parts, devices, and equipment shall be connected to the equipment grounding circuit.
 - f. Provide an equipment grounding terminal for each incoming power circuit, in the vicinity of the phase conductor terminal.
 - g. Design so that removing a device does not interrupt the continuity of the equipment grounding circuit.
 - h. Identify equipment grounding conductor terminals with the word "GROUND," the letters "GND" or the letter "G," or the color green.
 - i. Connect the door stud on the enclosures to an equipment-grounding terminal within the enclosure using an equipment-bonding jumper.
 - j. Signal (24 VDC) Grounding: Terminate each drain wire of a signal (shielded) cable to a unique grounding terminal block, or common ground bus at the end of the cable as shown on the Loop Drawings.
 - 1) Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding bus sized in accordance with NEC Table 250.122.
 - 2) Bond together all PLC or RTU racks (remote or local) processor racks, and conductive enclosures of power supplies and connect to the equipment grounding circuit.
8. Protection:
- 1) Provide disconnecting, short-circuit, and overcurrent protection for all control panels.
 - 2) Select and apply protective devices with proper consideration given, but not limited to the following:
 - a) System maximum available fault current at the point of application.
 - b) Interrupting rating of the protective device.
 - c) Voltage rating of the system.
 - d) Load and circuit characteristics:
 1. Normal operating current.
 2. Inrush characteristics.
 3. Thermal withstand capability (I_{2t}).
 4. Magnetic withstand capability (I_p).
 - e) Current-limiting ability of the protective device.

- f) Coordination of the protective devices to each other.
 - 3) Provide a separate protective device for each 120 VAC powered electrical device.
 - 4) Each 120 VAC Control Loop and Instrument shall have an individual circuit breaker within its respective control panel and clearly identified for function.
 - 5) Each 120 VAC and 24 VDC PLC output shall have its own individual fuse external of the I/O card with blown fused indication:
 - a) Size external fuse to open before any I/O card mounted fuses.
 - 6) Provide a protective fuse device for each PLC discrete output coordinated to open before the protective device on the PLC I/O card.
 - 7) Protective devices shall be located on the back mounting panel and identified by a service nameplate in accordance with the wiring diagrams.
 - 8) Provide dedicated single pole circuit breakers, one for the panel lighting luminaire(s), and one for the panel receptacle(s):
 - a) 15 amperes, 120VAC.
 - 9) The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be a non-faulting and non-interrupting design with a response time of less than 0.5 nanoseconds in normal mode and less than 5 nanoseconds in normal mode Peak surge current capability shall be rated for at least 15,000 amps, line to neutral, line to ground and neutral to ground.
 - a) Manufacturer: Control Concepts Model IC + 130/IC + 130WL rated 30 amps, or as directed.
9. Conductors and Cables:
- a. Power and Control Wiring:
 - 1) Materials: Stranded, soft annealed copper.
 - 2) Insulation: 600V type MTW.
 - 3) Minimum Sizes:
 - a) Primary power distribution: 12 AWG.
 - b) Secondary power distribution: 14 AWG.
 - c) Control: 16 AWG.
 - 4) Color:
 - a) AC power (line and load): BLACK.
 - b) AC power (neutral): WHITE.
 - c) AC control: RED.
 - d) DC power and control: BLUE.
 - e) Ground: GREEN.
 - b. Signal Cables:
 - 1) Materials: Stranded, soft annealed copper.
 - 2) Insulation: 600V, PVC outer jacket.

- 3) Minimum Size: 16 AWG paired triad.
 - 4) Overall aluminum shield (tape).
 - 5) Copper drain wire.
 - 6) Color:
 - a) 2 Conductor:
 - b) Positive (+): BLACK.
 - c) Negative (-): WHITE, RED.
 - 7) 3 Conductor:
 - a) Positive (+): BLACK.
 - b) Negative (-): RED.
 - c) Signal: WHITE.
 - 8) Insulate the foil shielding and exposed drain wire for each signal cable with heat shrink tubing.
10. Conductor Identification:
- c. Identify all conductors and cables with wire markers in accordance with Section 26 05 09
 - d. Readily identified without twisting the conductor.
11. General Wiring Requirements:
- e. Wiring Methods: Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise specified.
 - f. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.
 - g. Where the electrical power supply voltage to the control panel is more than 120 VAC, provide the panel with a control power transformer and flange mounted disconnect. The disconnect shall be mechanically interlocked with the control enclosure doors so that no door can be opened unless the power is disconnected. Interlocking shall be reactivated automatically when all the doors are closed.
 - h. Control panels supplied with 120 VAC:
 - 1) Provide an internal breaker with the line side terminals covered by a barrier.
 - 2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring that the source be disconnected before opening the door to the enclosure.
 - 3) Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.
 - 4) Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.
 - 5) Provide surge protection device on input supply power.
 - 6) Provide nonmetallic ducts for routing and organization of conductors and cables:

- a) Size ducts for ultimate build-out of the panel, or for 20 percent spare, whichever is greater.
- b) Provide separate ducts for signal and low voltage wiring from power and 120 VAC control wiring:
 - 1. 120 VAC: Grey colored ducts.
 - 2. 24 VDC: White colored ducts.
- 7) Cables shall be fastened with cable mounting clamps or with cable ties supported by any of the following methods:
 - a) Screw-on cable tie mounts.
 - b) Hammer-on cable tie mounting clips.
 - c) Fingers of the nonmetallic duct.
- 8) The free ends of cable ties shall be cut flush after final adjustment and fastening.
- 9) Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.
- 10) Support panel conductors where necessary to keep them in place.
- 11) Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.
- 12) Conductors and cables shall be run from terminal to terminal without splice or joints. Exceptions:
 - a) Factory applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.
- 13) The control panel shall be the source of power for all 120 VAC devices interconnected with the control panel including, but not limited to:
 - a) Solenoid valves.
 - b) Instruments, both mounted in the control panel and remotely connected to the control panel.
- i. Thermal Management:
 - 1) Provide heating, cooling, and dehumidifying devices in order to maintain all instrumentation and control devices to within a range as specified in Section 26 05 00.
 - 2) Air Conditioning:
 - a) Cooling:
 - 1. Provide filtered, fan forced type cooling system for each control cabinet.
 - 2. Size fans, louvers and filters to maintain a cabinet temperature no more than 10°F above ambient electrical room temperature.
 - 3. Cooling system includes the following components:
 - 4. Ventilation fans with louver and filter.
 - 5. Relief air louvers.

6. Thermostat.
 7. 5 micron air filters for each opening.
- b) Heating:
1. Provide all panels located in areas that is not climate controlled with thermostatically controlled strip heaters; except, where all of the following conditions apply:
 2. The panel is not supplied with 120 VAC power.
 3. There are no electronics or moisture-sensitive devices in the enclosure.
 4. The panel is smaller than 38 inches high.

2.4 COMPONENTS

A. Panel Meters:

1. Digital:
 - a. Self-contained instruments that display process signals directly in engineering units.
 - b. Suitable for panel mounting.
 - c. LED display:
 - 1) 0.56-inch height.
 - 2) Multi-range capabilities.
 - 3) Integral provisions for scaling.
 - 4) Switch programmable decimal points.
 - 5) NEMA 4/IP65 sealed front metal bezel.
 - d. Current and Voltage indicators:
 - 1) 3 1/2 - digit.
 - e. Accuracy:
 - 1) AC/DC volts: \pm (0.1 percent of reading + 2 digit).
 - 2) DC current:
 - a) 4 - 20mA: \pm (0.1 percent of reading + 1 digit).
 - b) 0 - 10V: \pm (0.1 percent of reading + 1 digit).
 - 3) Ratings, protection, and indication:
 - a) Maximum applied voltage: 300 VAC/VDC.
 - f. Operating voltage: 120 VAC.
 - g. Operating temperature: 0 degrees Celsius to 60 degrees Celsius.
 - 1) Manufacturer, One of the following
 - a) Red Lion.

B. Manual Operator Interface Devices:

1. General:

- a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.
 - b. Size:
 - 1) 30.5mm.
 - c. Lamp Color:
 - 1) On/Running/Start/Open: Green.
 - 2) Close/Off/Stop: Red.
 - 3) Power: White.
 - 4) Alarm: Red.
 - 5) Status or Normal Condition: White.
 - 6) Opened: Amber.
 - 7) Closed: Blue.
 - 8) Failure: Red.
2. Indoor and Outdoor Areas:
- a. NEMA type 4/13.
 - b. Heavy duty.
 - c. Pushbutton:
 - 1) Contacts rated:
 - a) NEMA A600.
 - 2) Furnish one spare normally open and normally closed contact with each switch.
 - 3) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.
 - 4) Manufacturer: One of the following:
 - a) Allen Bradley Type 800T.
 - b) Square D Class 9001 Type K.
 - c) General Electric Type CR104P.
 - d) IDEC TWTD.
 - d. Selector switches:
 - 1) Contacts rated:
 - a) NEMA A600.
 - b) Knob type:
 - 2) Manufacturer: One of the following
 - a) Allen Bradley Type 800T.
 - b) Square D Class 9001 Type K.
 - c) General Electric Type CR104P.
 - d) IDEC TWTD.
 - 3) Furnish one spare normally open contact and normally closed contact with each switch.
 - 4) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.

- e. Pilot lights:
 - 1) Type:
 - a) LED for all interior installations.
 - b) Full Voltage for exterior installations.
 - 2) Push to Test.
 - 3) LED Lamp.
 - 4) Manufacturer: One of the following
 - a) Allen Bradley Type 800T.
 - b) Square D Class 9001 Type K.
 - c) General Electric Type CR104P.
 - d) IDEC TWTD.

C. Relays:

- 1. General:
 - a. For all types of 120 VAC relays, provide transient surge protection across the coil of each relay.
 - b. For all types of 24 VDC relays, provide a free-wheeling diode across the coil of each relay.
- 2. General Purpose:
 - a. Magnetic control relays.
 - b. NEMA A300 rated:
 - 1) 300 Volts.
 - 2) 10 Amps continuous.
 - 3) 7,200 VA make.
 - 4) 720 VA break.
 - c. Plug-in type.
 - d. LED indication for relay energized.
 - e. Coil voltages: As indicated on the Drawings.
 - f. Minimum poles: 2PDT.
 - g. Touch safe design: All connection terminals to be protected against accidental touch.
 - h. Enclose each relay in a clear plastic heat and shock-resistant dust cover.
 - i. Quantity and type of contact shall be as shown on the Drawings or as needed for system compatibility.
 - j. Sockets for relays shall have screw-type terminals.
 - k. Provide additional (slave/interposing) relays when the following occurs:
 - 1) The number or type of contacts shown exceeds the contact capacity of the specified relays.
 - 2) Higher contact rating is required in order to interface with starter circuits or other equipment.
 - l. DIN rail mounting on 35mm rail.

- m. Ice Cube type relays shall be provided with retainer clips to secure relay in socket.
- n. Integrated label holder for device labeling.
- o. Manufacturer: One of the following:
 - 1) Phoenix Contact PLC series.
 - 2) Potter and Brumfield Type KRP or KUP.
 - 3) IDEC R* series. (* = H, J, R, S, U).
 - 4) Allen Bradley Type 700 H Series.
 - 5) Square D Type K.
 - 6) Turck
- 3. Machine Tool Relays:
 - a. Magnetic industrial relays.
 - b. NEMA A600 rated:
 - 1) 600 Volts.
 - 2) 10 Amps continuous.
 - 3) 7,200 VA make.
 - 4) 720 VA break.
 - c. Coil voltage: As indicated in the Contract Documents.
 - d. Convertible contact cartridges to convert any contact from a normally open to a normally closed configuration.
 - e. Contact cartridges shall have a clear cover for visual inspection.
 - f. Contact material shall be fine grade silver.
 - g. Minimum number of poles: 4 Type "A" or Type "B", or as indicated on the Drawings, plus 1 spare.
 - h. Machine tool type.
 - i. Touch safe design: All connection terminals to be protected against accidental touch.
 - j. Integrated label holder for device labeling.
 - k. DIN rail mounted on 35mm rail.
 - l. Manufacturer: One of the following
 - 1) Allen Bradley type 700P.
 - 2) Square D type 8501XO.
 - 3) Cutler Hammer D15 series.
- 4. Latching:
 - a. Magnetic latching control relays.
 - b. NEMA B300 rated:
 - 1) 300 Volts.
 - 2) 10 Amps continuous.
 - 3) 3,600 VA make.
 - 4) 320 VA break.
 - c. Plug-in type.

- d. DIN rail mounting on 35mm rail.
 - e. Coil voltage: 120 VAC.
 - f. Minimum poles: 2PDT; as indicated on the Drawings, plus 1 spare.
 - g. Touch safe design: All connection terminals to be protected against accidental touch.
 - h. Clear cover for visual inspection.
 - i. Provide retainer clip to secure relay in socket.
 - j. Manufacturer:
 - 1) One of the following, or equal:
 - a) Square D type 8501 Type K.
 - b) IDEC TWTD.
5. Time Delay:
- a. Provide time delay relays to control contact transition time.
 - b. NEMA A300 rated:
 - 1) 300 Volts.
 - 2) 10 Amps continuous.
 - 3) 7,200 VA make.
 - 4) 720 VA break.
 - c. Plug-in type.
 - d. DIN rail mounting on 35mm rail.
 - e. Coil voltage: as indicated in Contract Documents.
 - f. Provide Electronic type with on-delay, off-delay, and on/off delay.
 - g. Minimum poles: 2PDT; as indicated on the Drawings, plus minimum 1 spare.
 - h. Units shall include adjustable dial with graduated scale covering the time range in each case.
 - i. Minimum timing range: 0.1 seconds to 10 minutes.
 - j. Manufacturer: One of the following:
 - 1) Agastat type Series 7000.
 - 2) Allen Bradley type 700HR.

D. Terminal blocks:

- 1. Din rail mounting on 35mm rail.
- 2. Suitable for specified AWG wire.
- 3. Rated for 30 amperes at 600 Volts.
- 4. Screw terminal type.
- 5. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.
- 6. Finger safe protection for all terminals for conductors.
- 7. Construction: Polyamide insulation material capable of withstanding temperature extremes from - 40 degree Celsius to degree 105 Celsius.

8. Terminals: Plainly identified to correspond with markings on the diagrams:
 - a. Permanent machine printed terminal identification.
9. Identify terminals suitable for use with more than 1 conductor.
10. Position:
 - a. So that the internal and external wiring does not cross.
 - b. To provide unobstructed access to the terminals and their conductors.
11. Provide minimum 25 percent spare terminals.
12. Manufacturer: One of the following:
 - a. Phoenix Contact UK5 Series.
 - b. Entrelec M4/6.
 - c. Allen Bradley Series 1492.
13. Wire duct:
 - a. Provide flame retardant plastic wiring duct, slotted with dust cover.
 - b. Type:
 - 1) Wide slot.
 - 2) Narrow slot.
 - 3) Round hole.
 - c. Manufacturer: One of the following:
 - 1) Panduit.
14. Fuses (holders) and circuit breakers:
 - a. Fuse holders:
 - 1) Modular type:
 - a) DIN rail mounting on 35mm rail.
 - b) Touch safe design: All connection terminals to be protected against accidental touch.
 - c) Incorporates blown fuse indicator.
 - 2) Provide nameplate identifying each fuse:
 - a) In accordance with Section 16075.
 - 3) Manufacturer: One of the following:
 - a) Phoenix Contact.
 - b) Entrelec.
 - c) Allen Bradley 1492-FB Series B.
15. Control Circuit Breakers:
 - a. DIN rail mounting on 35mm rail.
 - b. Manual OPEN-CLOSE Switch.
 - c. Rated 250 VAC.
 - d. Interrupt Rating: As indicated on the Drawings.
 - e. Current ratings: As indicated on the Drawings.
 - f. Provide nameplate identifying each circuit breaker, refer:
 - 1) In accordance with Section 16075.
 - g. Manufacturer: One of the following:

- 1) Phoenix Contact.
- 2) ABB.
- 3) Allen Bradley Series.
- 4) Square D.
- 5) Entrelec.

E. Transient / Surge Protection Devices:

1. Provide Surge Protection Device (SPD) for Power Entrances:
 - a. Nominal 120 VAC with a nominal clamping voltage of 200 Volts.
 - b. Non-faulting and non-interrupting design.
 - c. A response time of not more than 5 nanoseconds.
2. Control Panel Power System Level Protection, non-UPS powered:
 - a. Design to withstand a maximum 10 kA test current of a 8/20 μ s waveform according to ANSI/IEEE C62.41.1-2002 Category C Area.
 - b. Provide both normal mode noise protection (between current carrying conductors) and common mode (between current carrying conductor and neutral) surge protection.
 - c. DIN rail mounting.
 - d. Attach wiring to the SPD by means of a screw type cable-clamping terminal block:
 - 1) Gas-tight connections.
 - 2) The terminal block: Fabricated of non-ferrous, non-corrosive materials.
 - e. Visual status indication of MOV status on the input and output circuits.
 - f. Dry contact rated for at least 250 VAC, 1 Amp for remote status indication.
 - g. Meeting the following requirements:
 - 1) Response time: \leq 100 ns.
 - 2) Attenuation: \geq - 40dB at 100 kHz as determined by a standard 50 ohms insertion test.
 - 3) Safety approvals:
 - a) UL 1283 (EMI/RFI Filter).
 - b) UL 1449 2nd Edition.
 - h. Manufacturer: One of the following:
 - 1) Phoenix Contact type SFP TVSS/Filter.
 - 2) Liebert Accuvar series.
 - 3) Islatrol.
3. Data and Signal Line Protectors – Panel Mounted:
 - a. Surge protection minimum requirements: Withstand a 10 kA test current of a 8/20 μ s waveform in accordance with ANSI/IEEE C62.41.1-2002 Category C Area.
 - b. DIN rail mounting on 35mm rail (except field mounted SPDs).
 - c. SPD's consisting of 2 parts:
 - 1) A base terminal block.

- 2) A plug protection module:
 - a) Replacing a plug shall not require the removal of any wires nor interrupt the signal.
 - b) Base and plug shall have the ability to be coded to accept only the correct voltage plug.
- d. SPD Manufacturer: One of the following:
 - 1) Phoenix Contact Plugtrab Series.
 - 2) Joslyn JMD Series.
- 4. Data and Signal Line Protectors – Field Mounted:
 - a. Surge protection minimum requirements: Withstand a minimum 10 kA test current of a 8/20 μ s waveform in accordance with ANSI/IEEE C62.41.1-2002 Category C Area.
 - b. Manufacturer: One of the following:
 - 1) Phoenix Contact type SFP TVSS/Filter.
 - c. SPD Manufacturer: One of the following:
 - 1) Phoenix Contact Pipetrab.
 - 2) Boxtrab.
 - 3) Joslyn JMD Series.

F. Power supplies:

- 1. Design power supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation.
- 2. Convert 120 VAC to 24 volt DC or other DC voltages required or as indicated on the Drawings.
- 3. Provide backup 24 VDC power supply units to automatically supply the load upon failure of the primary supply.
- 4. Provide power supplies configured as fully redundant units consisting of 2 power supplies connected with an automatic switchover unit with alarm contacts monitored by the PLC and alarmed in SCADA.
- 5. Sized to provide 40 percent excess rated capacity.
- 6. UL508C listed to allow full rated output without de-rating.
- 7. Provide fuse or short-circuit protection.
- 8. Provide a minimum of 1 set of dry contacts configured to change state on failure for monitoring and signaling purposes.
- 9. Output regulation: ± 0.05 percent for a 10 percent line change or a 50 percent load change:
 - a. With remote voltage sensing.
- 10. Operating temperature range: 0 degrees Celsius to 50 degrees Celsius.
- 11. Touch safe design: All connection terminals to be protected against accidental touch.
- 12. DIN rail mounting on 35mm rail.

13. Provide self-protecting power supplies with a means of limiting DC current in case of short circuit.
14. Manufacturer: One of the following:
 - a. Phoenix Contact Quint series.
 - b. IDEC PS5R series.
 - c. Sola.
 - d. Acopian.
 - e. Puls.

G. Intrinsic Safety Barriers:

1. Transformer isolated barrier:
 - a. Containing a transformer to provide complete:
 - 1) Isolation between the safe and hazardous areas for loop powered devices.
 - 2) 3-way isolation between the safe area, hazardous area and power supply powered devices.
 - b. Resistor for current limitation.
 - c. Fuses for short circuit protection.
 - d. Provide barriers with pluggable connectors that are coded for easy replacement.
 - e. Transmission error shall be less than or equal to 0.1 percent of full scale.
 - f. DIN rail mounted on 35mm DIN rail.
 - g. Approvals:
 - 1) FM.
 - 2) UL 913 & 1604.
2. Types:
 - a. Switch Isolators:
 - 1) Designed and approved for use with discrete inputs.
 - 2) Supply Power: 20-30VDC.
 - 3) Output to track input.
 - 4) With an LED in the cover to indicate the status of the input.
 - 5) With a selector switch to change the logic of the input.
 - 6) Input - dry contact.
 - 7) Output - SPDT relay.
 - b. Transmitter and Converters for use with 4-20 mA signals without Hart® communications capability:
 - 1) Designed and approved for use with 4-20 mA analog signals.
 - 2) Designed for powering 2 and/or 3 wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
 - 3) Supply voltage: 20-30VDC.
 - c. Transmitter and converters for use with 4-20 mA signals with Hart® communications capability:
 - 1) Designed and approved for use with 4-20 mA analog signals.

- 2) Designed for powering 2 and/or 3 wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
 - 3) In addition, transfer digital signals from the hazardous area to the safe area.
 - 4) Complete bi-directional communication between a smart transmitter located in the field and the suitable equipment located in the safe area.
 - 5) Supply voltage: 20-30VDC.
3. Manufacturer: One of the following:
 - a. Phoenix Contact ME Series.
 - b. Pepperl + Fuchs.
 - c. Turck.

H. Disconnects and starters:

1. Flange Mounted Main Disconnect:
 - a. Rated 22KAIC or as required by the short circuit and coordination study specified in Section 16305, whichever is larger:
 - 1) Size in accordance with the NEC, total connected horsepower and associated locked rotor current, and provide larger unit if needed based on any of these criteria.
 - b. Interlocked with the door of the control panel so that the door of the panel cannot be opened with the disconnect switch in the closed position, with defeater.
 - c. Door mounted disconnects are not acceptable.
 - d. Manufacturer: One of the following:
 - 1) Allen Bradley - 1494.
 - 2) Cutler Hammer - C361/C371.
 - 3) ITE - FH011.
 - 4) Square D - Class 94222.
2. Magnetic Motor Starters:
 - a. In conformance with the requirements of Section 16421.
 - b. Minimum 22 KAIC or as required by the Short Circuit and Coordination study, which ever is larger.
3. Integral Self-Protected Starters:
 - a. In conformance with the requirements of Section 16421.

I. Limit Switches:

1. NEMA-4X.
2. AC contact rating 120V, 10A.
3. DC contact rating 125V, 0.4A.
4. DeviceNet Compatible as indicated in the drawings.
5. Provide robust actuation mechanism not prone to degradation.

6. Provide complete actuator mechanism with all required hardware.
7. Allows for contact opening even during contact weld condition.
8. UL approved.
9. Operating Temperature Range: -18 degrees to +110 degrees Celsius (0 degrees to 230 degrees Fahrenheit).
10. Manufacturer:
 - a. Allen Bradley 802.
 - b. Honeywell HDLS.
 - c. Omron D4.
 - d. Eaton E47, E49, E50.
 - e. ABB equal.

2.5 ACCESSORIES

- A. Provide panels with an inside protective pocket to hold the panel Drawings. Ship panels with 1 copy of accepted Shop Drawings including, but not limited to, schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.
- B. Tag or identifying number of the panel as indicated on the Drawings.
 1. Provide in accordance with Section 16075 on all internal and external instruments and devices.
 2. Provide a nameplate with the following markings that is plainly visible after installation:
 - a. Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified.
 - b. Supply voltage, phase, frequency, and full-load current.
 - c. Short-circuit current rating of the panel based on one of the following:
 - 1) Short-circuit current rating of a listed and labeled assembly.
 - 2) Short-circuit current rating established utilizing an approved method.

2.6 FINISHES

- A. Finishes:
 1. Metal surfaces of panels shall be prepared by chemical cleaning and mechanical abrasion in accordance with the finish manufacturer's recommendations to achieve a smooth, well-finished surface.
 2. Scratches or blemishes shall be filled before finishing. One coat of zinc phosphate shall be applied per the manufacturer's recommended dry film thickness, and allowed to dry before applying the finish coat.

3. Finish coat shall be a baked polyester urethane powder, aliphatic air-dry polyurethane, or epoxy enamel to meet NEMA rating specified application.
4. Exterior of enclosures located outdoors shall be UV resistant polyester powder coating. Total dry film thickness shall be 3 mils, minimum.

B. Colors:

1. Exterior color of panels mounted indoors shall be manufacturer's standard light gray.
2. Exterior of panels mounted outdoors shall be manufacturer's standard white.
3. Panel interiors shall be manufacturer's standard white.

2.7 SOURCE QUALITY CONTROL

- A. Refer to Section 01 55 00.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Refer to Section 26 05 00.

3.2 INSTALLATION

- A. Any components or panels damaged during installation shall be replaced.
- B. Install enclosures so that their surfaces are plumb and level within $\pm 1/8$ inch over the entire surface of the panel; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to dry wall is not permitted.
- C. Install the enclosure per guidelines and submitted installation instructions to meet the seismic requirements at the project site.
- D. Provide floor stand kits for wall-mount enclosures larger than 48 inches high.
- E. Provide 3-1/2 inch high concrete housekeeping pads for free-standing enclosures.
- F. Install gasket and sealing material under panels with floor slab cutouts for conduit:
 1. Undercoat floor mounted panels.
- G. Provide a full size equipment-grounding conductor in accordance with NEC included with the power feeder. Terminate to the incoming power circuit-grounding terminal.

- H. All holes for field conduits, etc. shall be cut in the field, there shall be no additional holes, factory cut holes, or hole closers allowed. Incorrect holes, additional holes, or miss-cut holes shall require that the entire enclosure be replaced.
- I. Control panels that are adjacent to motor control centers shall be fully wired to the motor control centers using wireways integral to the motor control center or additional conduits as needed. These interconnections are not shown or reflected on the conduit schedule, but shall be shown on the Loop Drawings prepared by the CONTRACTOR.

3.3 FIELD QUALITY CONTROL

- A. Refer to Section 26 05 00.

3.4 CLEANING

- A. Clean area during construction in accordance with Section 01 50 00.

3.5 PROTECTION

- A. Refer to Section 26 05 00.

- END OF SECTION -

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SECTION 40 91 21
TEMPERATURE TRANSMITTER

PART 1 - GENERAL

1.1 THE REQUIREMENT

- A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 40 10 00 – Process Control and Information Systems
- B. Section 40 20 00 – Instruments, General

PART 2 - PRODUCTS

2.1 TEMPERATURE TRANSMITTERS

A. Room Temperature Transmitters

- 1. Pressure transmitter shall be 24-28 VDC powered from PLC panel power supply, Foxboro I/A Series, or equal. Power supply shall be VDC powered from PLC panel power supply. Transmitter shall be wall mounted with bare transducer element below sensing room temperature. Signal output shall be 4 to 20 mA.
- 2. Temperature transducer shall be RTD type. Element shall be bare connected directly to transmitter. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be +/- 0.0 degrees Fahrenheit.

B. Water Temperature Transmitters

- 1. Pressure transmitter shall be 24-28 VDC powered from PLC panel power supply, Foxboro I/A Series or equal. Signal output shall be 4 to 20mA. Transmitter shall be wall mounted with conduit for RTD cable.
- 2. Temperature transducer shall be RTD type. Element shall be submersible and connect to submersible RTD cabling with submersible connection. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be +/- 0.1 degrees Fahrenheit.

PART 3 - EXECUTION

3.1 REQUIREMENTS

- A. Refer to Section 40 20 00.

END OF SECTION

**SECTION 46 21 00
SCREENING EQUIPMENT**

PART 1. GENERAL

1.1 SECTION INCLUDES

- A. This section includes the furnishing and installing the automatic fine screen system, including a washing system and any other auxiliary accessories to be installed in the location as indicated on the drawings and as specified herein. Reference Sheet D-102.

- 1. The screen will be installed in the Class 1 Division 1 screen room, and the electrical control panel shall be installed inside the unclassified electrical room inside the headworks building. All equipment and electrical items furnished with the screening equipment shall be rated accordingly for the area classifications.

1.2 RELATED SECTIONS

- A. Section 01 22 00 - Measurement and Payment.
- B. Section 01 33 00 - Submittals.
- C. Section 01 40 00 - Quality Control.
- D. Section 01 75 16 – Startup Procedures.
- E. Section 01 78 23 – Operation and Maintenance Data.
- F. Division 26 – Electrical.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM) Publications:
 - 1. Section A322: Carbon and Alloy Steel Bar Specifications.
 - 2. Section A507-10: Standard Specification for Drawing Alloy Steel, Sheet, and Strip, Hot-Rolled and Cold Rolled
- B. American Institute of Steel Construction (AISC) Publications
- C. American Gear Manufacturers Association (AGMA)
- D. American Welding Society (AWS) Publications
- E. Steel Structures Painting Council, American National Standards Institute (SSPC)

F. National Electrical Manufacturers Association (NEMA)

1.4 SYSTEM DESCRIPTION

A. General

1. Each unit shall consist of a stationary, cylindrical screen basket, conveyor/dewatering screw, screenings press with the drive unit, support structure, screenings bagger attachment, and electrical and instrumentation control system.

B. Design Conditions

Table 1-1: Site Installation Information

Site Installation Information	Value
Channel Width:	36 inches
Top of Wall (at channel):	5779 ft elevation
Channel Bottom (top of channel grout):	5775.52 ft elevation
Screen Opening Size:	1/4 Inch
Angle of Installation:	35 Deg from the horizontal plane
Number of Screens:	1

Table 1-2: Flow Conditions

Flow Conditions	Value
Average Flow:	0.35 MGD
Peak Hour Flow:	0.93 MGD
Hydraulic Capacity per Screen, minimum:	1.57 MGD
Maximum Upstream Liquid Level:	12 inches
Maximum Clean Water Headloss:	6 inches

Table 1-3: Screen Design Information

Screen Design Information	Value
Nominal Screening Basket Diameter, minimum:	24 inches
Bar Spacing:	1/4 inches
Maximum Allowable Cleaning Cycle Time:	6 seconds
Speed Reducer Minimum Torque Rating:	15,700 in.lb
Speed Reducer Minimum Thrust Rating:	5,800 lbf

Table 1-4: Electrical Design Information

Electrical Design Information	Value
Drive Motor Size:	2 HP
Electrical Power Characteristics:	460/3/60 VAC-Phase-Hertz
Motor and Solenoid Valve Electrical Classification:	Class I – Division 1 – Group D Ex-proof
Electrical Enclosure Type:	NEMA 4X stainless steel

Table 1-5: Instrumentation Design Information

Instrumentation Design Information	Value
Liquid Level Sensing System Type:	Float Switches

Table 1-6: Conveyor Design Information

Conveyor Design Information	Value
Nominal Screw Conveyor Diameter:	8 inches
Minimum Screen Invert to Discharge Height:	79 inches

Table 1-7: Equipment Location Information

Equipment Location Information	
Equipment Location:	Indoors
Installation Area Classification:	Class I, Division I

Table 1-8: Ancillary Process Requirements

Ancillary Process Requirements	
Maximum Spray Wash System Flow Rate:	20 gal/min
Minimum Spray Wash System Pressure:	60 psig
Lower Wash System Number of Nozzles:	6

C. Performance

1. Screen

- a. The 3-plane cylindrical bar screen shall automatically screen wastewater flow. Screenings shall be washed, transported, compressed and dewatered by a single mechanism.
- b. The design of the screen shall be such that there are no metal-to-metal wearing surfaces in the screening, transport, and compaction/dewatering sections of the screen to minimize maintenance labor and replacement parts costs.
- c. The 3-plane cylindrical bar screen shall be a rotary raked, cylindrical bar screen with an integral screw conveyor and press. The 3-plane cylindrical bar screen shall use a single drive for screening, conveying, dewatering, and compressing screening material.
- d. The average bar screen flow through velocity shall not exceed 3.3 ft/sec (1.0 m/sec) under any flow condition up to the maximum hydraulic capacity noted in **Table 1-2**. The screen design shall minimize solids deposition in the channel.
- e. The cylindrical bar screen shall be a rotary raked, cylindrical bar screen with an integral screw conveyor and press. The cylindrical bar screen shall use a single

drive for screening, conveying, dewatering, and compressing screening material.

- f. The operation of the rake cleaning mechanism shall be automatically initiated at a preset high liquid level. Screens that operate continuously or via timer only will not be acceptable. The rake shall remove solids from the screenings basket and deposit them into the concentric screw conveyor trough after passing through a cleaning comb, where reverse movement of the rake shall provide positive cleaning of the rake mechanism. The screenings shall be transported up the screw conveyor and through a compaction/dewatering chamber.
- g. The screening equipment shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in method 9095B of EPA Publication SW 846.
- h. Due to the high solids loadings in wastewater, the entire screen basket shall be completely cleaned in no more than the maximum allowable time noted in **Table 1-3** to ensure minimum headloss and rapid cleaning of the screen. All open spaces of the screen shall be positively cleaned via teeth that pass through the full depth of the bars during each cleaning cycle. Spray wash water or screw flights with brushes will not be an acceptable method of cleaning the screen.
- i. The control system shall be designed so that the cleaning characteristics of the screen and spray wash systems can be changed via the programmable logic controller.

2. Screenings Washing

- a. Each screen shall be furnished with a minimum of two (2) separate screenings spray wash systems to flush organic material from the screenings prior to compaction and dewatering. The screenings washing systems shall be designed to minimize the amount of organic material in the screenings and to maximize solids dryness after compaction and dewatering. The screenings washing systems shall include:
 - i. The lower wash system shall be located immediately prior to the point where the screenings are removed from the screen and enter the screening transport tube. This wash system shall pre-wash the screenings to remove fecal material and to prevent material from sticking to the screw conveyor flights.
 - ii. The screenings wash system shall be located just prior to the beginning of the compaction zone after maximum maceration of the screenings by the

screenings transport screw conveyor. The screw conveyor shall be designed to prevent screenings from being washed down the screenings transport tube to the basket.

D. Odor Control

- a. To minimize odors and nuisance insect populations, the cylindrical screen transport system and compaction/dewatering system shall be completely enclosed.
- b. The spray wash systems shall be completely enclosed to prevent spray, aerosols, and leakage from coming in contact with the operating floor.

E. Materials Quality

- a. All fabricated components of the screen shall be AISI Type 304 stainless steel including the screen basket, screw conveyor, outer screw conveyor housing, and support structure. Materials thicknesses identified in **PART 2 - PRODUCTS** are the minimum requirements for this project. Materials with increased thicknesses will be acceptable.

1.5 PREQUALIFICATION

- A. All equipment manufacturers not listed in the specifications shall submit prior to the advertised date for receipt of bids a "Qualification Package" for the substitute or "or equal" equipment that the manufacturer proposes to furnish in lieu of products identified in the Contract Documents. The Bidder shall submit the Qualification Package under separate cover. Each Qualification Package shall be an electronic pdf, identifying the specification section number and title, and the product manufacturer's name on a cover sheet. The manufacturer shall submit the Qualification Package to the contact provided in the advertisement or instructions to bidders. This section outlines the procedures for the proposal of substitute or "or equal" items.
- B. Provide a copy of this specification with a check next to each item to which the proposed equipment meets the specified standard. Where the proposed equipment does not strictly meet the requirements of this specification, provide information on the proposed exception to the specification that would bring the proposed, equipment into compliance with the requirements of this section.
- C. Confirmation that the manufacturer has regularly engaged in the manufacturing and production of cylindrical screen equipment in the United States for a minimum of ten years.

-
1. The manufacturer must have installed and had in satisfactory use in this application a minimum of ten U.S. municipal installations of an identical type and size of the above-described units.
 2. Provide a list of five equipment installation references with contacts.
 - a. Name and location of installation.
 - b. Name of the person who is directly responsible for the equipment.
 - c. Address and phone number of the person responsible for the equipment
 - d. Month and year the equipment was placed in operation.
 - D. Hydraulic performance curves showing the relationship of headloss versus the full range of downstream liquid depths for the flow design points (average and peak), including minimum hydraulic capacity noted above.
 - E. A maintenance schedule showing the required maintenance, frequency of maintenance, lubricants, and other items required at each regular preventative maintenance period, including all buy-out items.
 - F. A sample process equipment electrical requirements and schematic diagrams
 - G. If the Bidder fails to furnish all of the preceding information which has been deemed necessary by the Engineer to evaluate a proposed substitute or "or equal" equipment, the proposed substitute or "or equal" qualification package will be rejected by the Engineer.
 - H. The Engineer shall be the sole authority for determining conformance of a proposed substitute or "or equal" equipment item or product with the minimum requirements of the Contract Documents. Under no circumstances will the Engineer be required to prove that an "Alternate" major equipment item or product is not equal to the specified equipment item or product.
 - I. Failure to furnish the preceding information shall be cause for rejection of a proposed substitute or "or equal" equipment item or product for use on this project.

1.6 SUBMITTALS

- A. The following information shall be submitted in accordance with Section 01 33 00:
 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall

denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Vendor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Owner shall be the final authority for determining the acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Process and Instrumentation Diagrams (P&ID's)
 - a. For the entire Vendor supplied system. P&IDs shall clearly indicate where the supplied system will interface with the Owners mechanical, electrical, and control systems.
3. Vendor supplied Bill of Materials.
4. Vendor supplied equipment electrical load list.
5. General arrangement drawings
 - a. General arrangement drawings showing the entire assembly. This shall include a materials list and descriptions of all major components such as all valves or other mechanisms (sizes, capacities, piping connections, ASTM designations where appropriate, thicknesses, and construction).
6. Catalog information for all components, materials lists, and additional information describing the conformance of the proposed equipment with the design and operating requirements of the screening system.
7. Hydraulic Performance
 - a. Provide hydraulic performance curves showing the relationship of headloss versus the full range of downstream liquid depths for all flow conditions described in **Table 1-2 Flow Conditions**.
8. Shop and field painting systems.
 - a. Include manufacturer's descriptive technical catalog literature and specifications.
9. Manufacturer's data

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- a. Provide manufacturer's data including product literature, materials of construction, construction details of equipment, wiring diagrams, and weight of equipment.

10. Wiring diagrams

- a. Provide elementary and connection wiring diagrams clearly showing external connections to other equipment.

11. Concrete anchor calculations

- a. Provide concrete anchors calculations for manufacturer-provided equipment.

12. Rating, AGMA, and ASTM designations, construction, and detailed descriptions of all gears, reducers, and drives.

13. Layout drawings, wiring diagrams, and catalog information detailing all instruments, controls, and control panels, including complete electrical wiring diagrams (elementary or control schematics), interconnection diagrams, and communication network diagrams

14. SCADA

- a. Process control system configuration parameters are available to be read/written by the Owner's SCADA system, with register address, bit assignment, and setting value (range of value). The vendor shall indicate which, if any, parameters the Vendor system requires from the Owner's SCADA for the automated operation of the Vendor system.

15. PLC Logic

- a. A written overview of the process control system PLC control logic explaining the sub-routine program including control, monitoring, alarming and interlock functions.
- b. Annotated PLC application program logic code, with a written control description that describes the application program code in non-technical terms using a clear sentence structure that includes the sequence of events, interlocks, and action on fault conditions. Hard copy and an electronic copy shall be provided in the native program and PDF.

16. Factory Testing

- a. Factory test plans for the control system panel(s)

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- b. Factory test reports documenting conformance to Vendor specified design criteria for the control system panel(s)

17. Onsite Testing

- a. Proposed on-site testing and start-up procedures.

18. Operation and maintenance information and manuals

- a. Provide based on Section 01 78 23 Installation, Operation, and Maintenance Manual.
- b. Maintenance schedule to show the required maintenance, frequency of maintenance, lubricants, and other items required at each regular preventative maintenance period.
- c. Operation Data to include manufacturer's instructions, description of system operation, startup data, trouble-shooting checklists, and repair data.

1.7 QUALITY ASSURANCE

A. All equipment supplied under this Section shall be furnished by a single Screening System Supplier who shall coordinate with the Contractor, the design, fabrication, delivery, installation, and testing of the screening and Washer-Compactor components. The Screening System Supplier shall have the sole responsibility for the coordination and performance of all components of the screenings system with the performance and design criteria specified herein.

- 1. The equipment manufacturer shall, in addition to the contractor, assume the responsibility for the proper installation and functioning of the equipment.
- 2. Naming a manufacturer does not relieve them from complying with the performance features, the salient features, and the Made in the U.S.A. requirements of the Contract Documents.
- 3. The contract documents represent the minimum acceptable standards for the equipment. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. The entire unit shall be 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 specification.

B. The manufacturer shall have a minimum of ten (10) years of experience producing equipment substantially similar to that required and shall be able to submit documentation of at least ten (10) independent installations using the same size or

larger equipment as detailed below. Each installation must have been in satisfactory operation for at least five (5) years.

C. Fabrication

1. Fabrication shall be done in compliance with all applicable ASTM standards or equivalent international standards.

D. Testing

1. The equipment shall be fully assembled, and shop tested at the manufacturing facility prior to shipment. Shop testing shall include a minimum of 4 hours of run time. The Contractor, the engineer, the Owner, or the owner's designated representative reserves the right to witness the shop test. A minimum three (3) week notice shall be provided prior to the test to allow for travel coordination.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. All equipment shall be shipped and delivered fully assembled except where partial disassembly is required in order to conform to transportation regulations or for the protection of components.
- B. The Contractor shall be responsible for the unloading of the machinery and must have equipment on-site at the time of delivery that is capable of hoisting the units and moving them for disassembly, reassembly, and installation.
- C. Shipping, handling, and storage instructions shall be submitted with the equipment submittal per Section 01 33 00 Submittals.

1.9 WARRANTY

- A. Equipment supplied under this section shall be warranted to be free from defects in workmanship, design, and materials for a period of two (2) years 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.
- B. All warranty repairs/replacement shall include labor, materials, and travel costs necessary for repairs at the job site.

PART 2. PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design

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1. Lakeside Raptor 3-Plane Cylindrical Screen (with associated equipment items specified herein) was used as the basis of design for the project.

B. Approved Manufacturers:

1. LakeSide (Basis of Design)
2. Pre-approved “or-equals” in accordance with Instructions to Bidders and **1.5-Prequalification.**

2.2 SCREEN COMPONENTS

A. Screen Basket

1. The screen shall be designed and built to withstand the maximum possible static hydraulic forces exerted by the liquid on the screen. All structural and functional parts shall be sized to prevent deflections or vibrations that may impair the screening, conveying, and pressing operations. All submerged components and all components of the screen in contact with the screened solids shall be of stainless-steel construction.
2. The screen basket shall be of a cylindrical shape that shall be open at the top. The screen bars shall be perpendicular to the centerline of the screen. The basket ring support bars shall have adequately machined slots so that the rake teeth can penetrate the basket ring bars to ensure proper cleaning of the full basket depth.
 - a. The minimum diameter of the screening basket shall be as noted in **Table 1-3: Screen Design Information.**
3. The screen basket shall use graduated depth bars to provide three (3) distinct screening planes (bar heights) on the screen interior to provide superior solids capture and removal from the flow. .
 - a. The width of the screening channel shall be as noted in **Table 1-1: Site Installation Information.**
4. Each ring shall be fabricated from sections that have been cut from flat cold rolled stainless steel sheet to minimize warping of the rings. Basket ring designs manufactured from rolled bar stock into rings will not be acceptable for this project. Each basket ring section shall be provided with an integral strengthening gusset at each attachment point to the support bars for added basket strength. The stainless steel support bars shall be machined with slots to provide the proper bar spacing as specified in paragraph 1.03.C.6. Each basket ring shall be inserted into the machined slot of the basket support bars and then welded to the support bars to provide a superior strength basket design. To ensure basket strength, the

minimum ring heights for the 3-plane cylindrical basket shall be 3/4 inch, 1 inch, and 1-1/2 inch.

5. The main screen basket upper support ring shall be a minimum of 5/8-inch thick and shall be machined to match the transport tube main support flange to ensure proper alignment of the basket and the rotating rake arm . The main screen basket lower support ring shall be 7/8-inch minimum thickness.
 6. The minimum diameter of the screening basket shall be as noted in **Table 1-3**. The basket diameter shall be matched with a sufficient number of bar spacings to ensure the maximum hydraulic capacity flow rate noted in **Table 1-2** is achieved and to provide less than the maximum headloss noted in **Table 1-2**.
 7. A hinged protective guard fabricated of 12-gauge minimum thick stainless steel or FRP shall be provided to cover the open top of the screen basket. Hinges and mounting hardware shall be stainless steel
 8. Side seal plates shall be provided to enclose the circular screen and the rectangular concrete channel. Side seal plates shall be two-piece fabricated of 10 gauge minimum stainless steel and shall be of sufficient height to prevent bypassing of flow around the screen at the maximum hydraulic capacity flow rate noted in **Table 1-2**.
 9. The screen shall be provided with a pivoting support stand allowing for easy removal of the screen basket from the channel for maintenance purposes. To ensure operator safety during servicing of the screen, supports and support stand shall be fabricated from 1/4 inch minimum stainless steel shapes and plates.
 10. A set of stainless steel lower screen basket support brackets fabricated of 1/4-inch sections shall be provided to support the basket in the channel. Support brackets shall allow vertical adjustment of the screen basket so that it does not rest on the channel floor.
- B. Rotating Rake and Cleaning Comb
1. The rotating rake assembly shall penetrate the depth of the bar screen to ensure positive solids removal. Rake shall be water-jet cut stainless steel for superior life. Rake tooth root design shall match the 3-plane design of the basket rings to ensure proper cleaning of the screen bars.
 2. The rake shall reverse at least once during the cleaning cycle to pass through the topmost position where it shall be cleaned by a water-jet cut stainless steel hinged cleaning comb installed at the top of the screen basket. The cleaning comb shall be designed to match the rake profile to ensure cleaning of the spaces to the root of each tooth in the 3-plane rake design. Cleaning comb shall be supported at

both ends and shall pivot and return to the standby position without the use of counterweights.

3. The rotating rake and the screw conveyor shall be fixed to the same shaft and driven by a common drive.
4. A stainless steel backed nylon brush shall be attached to the rake arm and positioned to make contact with the screening trough to sweep material caught on the edges of the trough.

C. Screenings Conveyor and Screenings Dewatering Press

1. The screenings screw conveyor transport tube nominal diameter shall be as **Table 1-6** with a minimum Schedule 10S pipe wall thickness. A minimum of three (3) anti rotation bars with 1/4 inch minimum thickness shall be welded to the inside of the transport tube along the longitudinal axis from the compaction zone to the beginning of the screenings collection trough. The screenings screw conveyor shall not depend on support from the anti rotation bars during normal operation.
2. A basket support plate flange shall be a minimum of 5/8-inch and shall be welded to the lower end of the screenings transport tube complete with strengthening gussets to attach the screen basket and to provide for attachment of the screenings collection hopper. A 5/8-inch minimum thick drive support flange shall be welded to the upper end of the screenings transport tube for attachment of the drive assembly. After all welding of components to the screenings transport tube have been completed the fabrication shall be placed in a lathe to machine the face of the upper drive flange, to machine the face of the lower basket support plate flange for mating the basket and to machine the lower bearing housing. A 1/2-inch thick minimum drive assembly adaptor stainless steel flange shall be provided to bolt to the upper drive support flange.
3. The dewatering screw shall be designed to transport and dewater the screened material. Screw flights shall be stainless steel with a minimum thickness of 3/16-inch with increased 3/8-inch thick minimum thickness in the screenings collection trough and in the compaction/dewatering zone. Where the transport screw passes through the discharge section a screenings cutter shall be provided to cut off the compacted material plug to drop into the receiving receptacle. Flight pitch distance shall be a maximum in the screenings collection hopper and shall be reduced along the length of the screenings transport tube to a minimum pitch distance in the compaction zone.
4. The upper and lower screenings conveyor torque tube shall be fitted with a solid stainless steel stub shaft. The shafts and screenings screw conveyor torque tube shall be accurately machined in accordance with **Table 1-3** to allow a shrink-fit and welded design for the upper drive end stub shaft and lower tail bearing stub shaft.

Bolting the stub shafts to the screening transport screw conveyor torque tube will not be acceptable for this project.

5. The lower end of the screenings conveyor shall be supported by a sealed, self lubricated lower polymeric composite sleeve bearing with stainless steel wear sleeve. Metallic-based lower bearings will not be acceptable for this project. The lower bearing shall not take any thrust load from the screw conveyor. A minimum of two UHMW retainer seal plates shall be provided to prevent material intrusion into the bearing seals. The stainless steel bearing housing shall be field replaceable and shall be machined to mate with the screenings collection trough by a bolted flanged connection. Designs in which the bearing housing is welded directly to the screen trough will not be acceptable for this project.
6. Rake arm attachment hub outer diameter shall match the outer diameter of the stationary bearing housing to minimize material wrapping around the shaft. The rake arm attachment hub shall be split to provide compression fit along with locking bolts and keyway.
7. Drainage holes shall be provided along the entire length of the screenings collection trough invert to allow for gravity drainage of wash water without flushing screenings out of the trough. Drainage hole diameter shall be smaller than the bar spacing noted in **Table 1-3**. The width of the drainage section shall be based upon a minimum 65-degree arc. The drainage section perforated plate material shall be fabricated from 11 gauge minimum thick stainless steel and shall have a minimum 50% open area for free water drainage.
8. A compaction zone shall be an integral part of the screenings screw conveyor and transport tube design. The compaction zone shall be designed to form a screenings plug of material and to return water released from the screened material back to the wastewater channel through circular holes that are machined into the screenings transport tube. The compaction zone shall be fabricated from 12 gauge minimum thick stainless steel welded to the screenings transport tube to provide a watertight collection chamber. The compaction zone housings that are non-metallic and which require seals to prevent leakage around the screenings transport tube will not be acceptable for this project. The compaction zone housing shall be furnished with a hinged and sealed access cover held in place with stainless steel latches as well as a removable dewatering section panel inside the dewatering chamber to allow direct access to the screw conveyor should the compaction zone ever become plugged. Designs that require removal of the drive assembly, discharge head or screw conveyor to gain access to the compaction zone will not be acceptable for this project.
9. Water that is released from the screenings shall be returned via a reinforced rubber hose attached to the dewatering section. Drain design shall allow for

removal and cleaning of the drain hose should it ever become plugged without removing the drive, discharge head or screw conveyor.

10. The screen shall be designed with a minimum discharge height as noted in **Table 1-6** as measured from the channel invert.

D. Drive Assembly

1. The screw conveyor shall be driven by a direct-connected cycloidal-helical hollow-shaft high-thrust in-line speed reducer as shown on the drawings. The cyclo element of the speed reducer shall be designed to take a 500 percent shock load without damage. The speed reducer manufacturer shall be a member of AGMA. Combination gear motor designs will not be acceptable for this project.
2. The speed reducer shall be bolted to the drive adaptor flange at the upper end of the screenings transport tube.
3. The speed reducer shall be driven by a field replaceable NEMA C flanged, 1,800 rev/min, ball bearing, continuous duty, totally enclosed, fan-cooled motor with leads to a large conduit box. The reducer shall utilize a tapered grip bushing to connect to the drive shaft of the screw conveyor. The use of keys and keyways will not be an acceptable connection method for this project.
4. Motor size shall be as noted in **Table 1-4: Electrical Design Information** and shall be rated for appropriate electrical power characteristics and environment. Explosion-proof motors shall be furnished with over-temperature thermostats in the windings designed for a cutout at approximately 160°C.
5. Chain drives, belt drives, hydraulic drives, or a separate upper bearing for the transport screw will not be acceptable for this project.
6. A proximity sensor for locating the rake position shall be mounted to the outer drive housing with a fabricated stainless steel bracket. Limit switches or other electro-mechanical position sensing devices will not be acceptable for this project.

E. Spray Wash Systems

1. Three (3) spray systems shall be provided. Each spray wash system shall be furnished with a control solenoid valve, stainless steel piping and fittings, flexible reinforced PVC hose, and nozzles. Piping, fittings, and valves shall be 3/4-inch diameter minimum. A plant water strainer shall be provided for the incoming plant water supply. The wash water flow and minimum pressure requirements shall be as noted in **Table 1-8: Ancillary Process Requirements**. The three (3) spray wash systems shall include:

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- a. The lower spray wash system shall be located near the upper end of the screenings basket just prior to where screenings enter the screw conveyor transport tube. Lower spray wash bars without replaceable spray nozzles will not be acceptable.
 - b. The screenings spray wash system shall be located in the upper section of the transport tube no more than 17 inches from the beginning of the compaction zone to break up and return organic materials to the flow stream and to ensure maximum screenings washing. A minimum of one (1) spray nozzle shall be provided. The screenings spray wash system and screenings screw conveyor shall be designed to prevent washing screenings down the center of the screw conveyor.
 - c. The dewatering chamber flush water system shall periodically clean the compaction and dewatering zone via a stainless-steel wash nozzle located in the compaction/dewatering chamber. The dewatering chamber flush water system shall not be a substitute for the screenings washing systems.
2. The wash system solenoid valves shall be 3/4-inch minimum, brass body suitable for 120 VAC operation. Solenoid valves shall be normally closed and rated for up to 150 psig. Solenoid valves shall be the slow close type to minimize water hammer.
 3. Solenoid valves shall be factory installed to a piping manifold to ensure even pressure distribution to each spray wash system. The solenoid valve wiring shall be factory installed to a common junction box on the spray wash manifold for wire nut connection to external power. Conduit and fittings shall be factory installed between the solenoid valves and junction boxes. The junction box, conduit, and fittings shall be rated NEMA 4/7/9 for an explosion-proof electrical environment.
 4. A water strainer shall be provided that is suitable for a 3/4-inch NPT connection and a maximum flow rate and suitable for a maximum pressure as noted. Water filter shall be a stacked filter element design with washable 80-mesh (200-micron) polyethylene or polypropylene disc elements, polypropylene head and bowl, and Buna N gaskets. Y-type strainers will not be acceptable for this project.
- F. Screenings Bagger
1. The discharge chute shall be furnished with a bagging device to contain and encase dewatered screenings.
 2. The bagging device mounting assembly shall be fabricated of 12-gauge minimum stainless steel.

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3. The screenings bagger shall be designed to be fitted with individual replaceable plastic bags held in place via a nylon strap. Bagger shall be supplied with 100 individual bags.

G. Anchor Bolts

1. The equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Bolts, washers, and hex nuts shall be 304 stainless steels unless noted otherwise. Anchor bolts shall be drilled-in -epoxy type stainless steel.
2. Anchor bolts shall be set by the contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.3 CONTROL SYSTEM

- A. All controls necessary for the fully automatic operation of the semi-cylindrical screen shall be provided in accordance with NEMA standards.
- B. A position sensor and target shall be externally-mounted on the drive unit for ease of operator access and shall provide a "home" location for cylindrical bar screen operation during the cleaning cycle. Position sensors with internally-mounted targets inside the screenings screw conveyor will not be acceptable for this project.
- C. The dual float switches shall be a non-mercury switch enclosed in an ABS housing. The switches shall operate over a narrow switching angle and have a minimum rating of 1 amp at 120 volts. A 40 ft neoprene jacketed power cable, weight, grip cord, and stainless steel mounting bracket shall be furnished as part of the switch assembly. The level switching circuit shall be rated intrinsically safe by inclusion of a UL approved switch isolator with relay output. The switch isolator shall be rated for 120-volt service with output contacts rated for 2 amps minimum. A second high-level float switch shall be included for alarm indication.
- D. Remote mounted main panel suitable for wall mounting shall contain the following items:
 1. Door interlocked fused disconnect
 2. Process controller complete with LCD display providing field settable/adjustable/access to process parameters and for providing specific indications of each type of fault that may occur. Controller ram shall be backed up with non-volatile memory which will load automatically if ram is corrupted.
 3. Variable frequency drive (VFD) with line reactor

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4. Control power transformer fused primary and secondary with 120VAC transient voltage surge suppressor (TVSS)
 5. Full voltage LED pilot lights for the following:
 - a. Control power on (White)
 - b. Screen run (Green)
 - c. Multifunctional overload shutdown/screen fault (Red)
 - d. Screen upstream high water level alarm (Amber)
 6. Non-resettable elapsed time meter for the screen drive
 7. Remote dry contact outputs for the following:
 - a. Screen run
 - b. Multifunctional overload shutdown/screen fault alarm
 - c. Screen upstream high water level alarm
 8. White phenolic nameplates with black lettering
 9. 600 VAC terminal block
 10. U.L. panel label per the application
 11. Electrical enclosure shall be provided in accordance with paragraph 1.03.C.21.
- E. A local mounted operator control station shall contain the following items:
1. Hand-Off-Auto selector switches for the following:
 - a. Screen drive
 - b. Common wash system solenoid valves
 2. Forward-Off-Reverse selector switch (spring return to center) for screen drive
 3. E-stop pushbutton (Red)
 4. Re-set push button (Black)
 5. White phenolic nameplates with black lettering
 6. NEMA 4/7/9 cast aluminum explosion-proof enclosure

2.4 SHOP SURFACE PREPARATION AND PAINTING

- A. Electric motors, speed reducers, and other self-contained or enclosed components shall have manufacturer's standard enamel finish.
- B. All external non-wetted stainless steel shall be cleaned to a uniform finish by glass bead blasting, chemical pickling, and passivation. No hazardous wastes shall be produced during fabrication. The semi-cylindrical screen manufacturer shall clearly identify the passivation procedure methodology and shall certify that no hazardous wastes were produced.

2.5 SOURCE QUALITY CONTROL

- A. All structural stainless-steel components shall be fabricated in the United States and shall conform to the requirements of "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" published by the American Institute of Steel Construction.
- B. All parts and assemblies shall be fabricated from sheets and plates of AISI Type 304 stainless steel with a finish conforming to ASTM A666, unless noted otherwise. All rolled or extruded shapes shall be fabricated to conform to ASTM A276. All tubular products and fittings shall be fabricated to conform to ASTM A312, A351, and A403.
- C. All welding in the factory shall use shielded arc, inert gas, MIG, or TIG method. Add filler wire to all welds to provide for a cross-section equal to or greater than the parent metal does. All butt welds shall be full penetration type to the interior surface. Provide gas shielding to the interior and exterior of the joint.
- D. Welding of the screen components shall be in accordance with the latest edition of the American Welding Society (AWS) standards. Field welding of stainless steel will not be permitted.
- E. Bolts, nuts, and washers shall be AISI 304 stainless steel furnished in accordance with ASTM A193.
- F. All surfaces that are specified to be machined shall be designed and fabricated to provide a runout of not more than 0.005 inches and concentricity to within 0.005 inches.
- G. The design and fabrication of structural steel members shall be in accordance with AISC and AWS Standards. The manufacturer shall comply with the American Welding Society (AWS) and the American Institute of Steel Construction (AISC) most current listed standards and qualifications in 2004 D1.1, the criteria per the requirements of Section 6 - Inspection - Structural Welding Code. Evidence of such AWS and AISC compliance shall be submitted with a shop drawing submittal as follows:

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1. AWS Certified Welding Inspector shall conform to all standards, current or previous as listed in section 6.1.4 AWS QC1, Standard and Guide for Qualification and Certification of Welding Inspectors.
 2. AWS Non-Destructive Testing Inspector (Level I, II, III) for Magnetic Particle and Ultra-Sonic testing shall conform to all standards, current or previous as listed in and in conformance with The American Society for Non-Destructive Testing (ASNT-TC-1A).

2.6 SHOP SURFACE PREPARATION AND PAINTING

- A. Electric motors, speed reducers, and other self contained or enclosed components shall have manufacturer's standard enamel finish.
- B. All external non-wetted stainless steel shall be cleaned to a uniform finish by glass bead blasting and chemically treating with Citrisurf 2210 or 2050, or equal. No hazardous wastes shall be produced during fabrication because Citrisurf is a citric acid based product that is non-toxic. The cylindrical bar screen manufacturer shall clearly identify the passivation procedure methodology and shall certify that no hazardous wastes were produced.

2.7 LUBRICANTS

- A. The Contractor shall furnish all necessary oils, lubricants, grease guns, or other necessary applicators and shall lubricate the mechanical equipment prior to initial operation. The grade of oil and grease furnished by the Contractor shall be in accordance with the recommendation of the equipment manufacturer. The Contractor shall supply a 12-month supply of each lubricant.

2.8 SPARE PARTS

- A. The following spare parts shall be provided:
 1. One (1) complete solenoid valve assembly
 2. One (1) solenoid valve re-build kit
 3. One (1) lower bearing element with stainless steel wear sleeve and seals
 4. Three (3) spare fuse sets of each size and type
- B. Spare parts shall be individually boxed with the project name and part number clearly identified on each individual box. All spare parts shall be shipped in a separate crate and clearly labeled. Spare parts shall be stored indoors by the Contractor in a temperature-controlled environment.

PART 3. EXECUTION

3.1 FIELD PREPARATION AND PAINTING

- A. The Contractor shall touch up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.
- B. The Contractor shall supply paint for field touch-up and field painting.
- C. The Contractor shall finish painting electrical motors, speed reducers, and other self-contained or enclosed components with oil resistance enamel.
- D. Prior to assembly, the Contractor shall coat all stainless-steel bolts and nut threads with a non-seizing compound.
- E. The contractor shall provide a crane of sufficient capacity for unloading the equipment from the truck and placing it in the channel for installation.

3.2 INSTALLATION

- A. The Contractor shall employ qualified competent personnel for the installation, testing, and start-up of all equipment.
- B. The contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of significant deviations.
- C. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractor shall install the anchor bolts in accordance with the manufacturer's recommendations.
- D. Install electrical and control components in accordance with the manufacturer's recommendations and the electrical division of these Technical Specifications.
- E. After the equipment has been placed into operation, the manufacturer's representative shall make all final adjustments for proper operation.

3.3 STARTUP SERVICES

- A. Perform system start-up and field testing in accordance with Sections 01 75 16 Starting of Systems.
- B. The factory-trained representative shall demonstrate the proper and sequential operation of the screen.

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- C. The manufacturer shall schedule one (1) trip to the project site for equipment start-up assistance for the contractor and for operating training for owner personnel.
 - D. After the contractor has installed the screen and the equipment is capable of being operated, the equipment manufacturer shall furnish a qualified representative for a minimum of two (2) days (up to 16 hours) to perform start-up inspection of the equipment and training for the contractor.
 - E. Contractor shall carefully coordinate equipment, motors, drives, and controllers so that the completed system operates satisfactorily under all operating conditions.

3.4 FIELD TESTING

- A. Prior to final acceptance of the screen, three (3) tests shall be conducted according to the EPA Paint Filter Test as described in method 9095B of EPA Publication SW 846.
- B. Should the system fail to produce screenings capable of passing the "EPA Paint Filter Test", the manufacturer shall at its own expense make all necessary modifications to the equipment until such tests can be passed.

3.5 OPERATOR TRAINING

- A. Provide operator training for OWNER'S personnel after system is operational. Training will take place while manufacturer's representative is at the job site for inspection.

END OF SECTION