

**BID DOCUMENTS, CONTRACT DOCUMENTS AND
CONSTRUCTION SPECIFICATIONS**

FOR

WATER TREATMENT PLANT

FOR THE

CITY OF MILLEDGEVILLE, GEORGIA

Elected Officials

Mary Parham-Copelan, *Mayor*

Collinda Lee

Jeanette Walden

Denese R. Shinholster

Walter Reynolds

Shonya A. Mapp

Steve Chambers

Hank Griffeth, *City Manager*

Robert L. Hadden, *Water and Sewer Director*

AUGUST 2025

PROJECT NO. 232645

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Prepared by:



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**SECTION 00 01 13
ADVERTISEMENT FOR BIDS**

**City of Milledgeville, Georgia
119 East Hancock Street, Milledgeville, Georgia 31061
Lamar Ham Water Treatment Plant Renovation, Contracts I and II
Bid No. 60550-2026-0003**

General Notice

The City of Milledgeville, Georgia (Owner) is requesting Bids for the construction of the following Project:

**Lamar Ham Water Treatment Plant Renovation, Contracts I and II
Project Number: 232645**

Bids for the construction of the Project will be received at the City Hall located at 119 East Hancock Street, Milledgeville, Georgia 31061, until **December 11, 2025 at 2:00 PM** local time. At that time the Bids received will be publicly opened and read.

The Project includes the following work:

Contract I

Additions to the existing water treatment plant including construction of a new Control Building, Chemical Feed Systems and Structures, Rapid Mix Structures, Clearwell, and High Service Pump Station, along with all related building, site, piping, electrical and other associated modifications.

Contract II

Additions to the existing water treatment plant including construction of a new Full Scale Pilot filtration system, including demolition, renovation, excavation, backfill, structures, piping, drains, and appurtenances, electrical, mechanical and other associated modifications.

Bids are requested for the following Contract: City of Milledgeville, Georgia, Lamar Ham Water Treatment Plant Contracts I and II, August 2025, Project Number 232645

The Project has an expected duration of:

Contract I: 540 days for substantial completion and 570 days for final completion.

Contract II: 270 days for substantial completion and 300 days for final completion

Obtaining the Bidding Documents

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

<https://turnipseed.com/current-projects/out-for-bid/>

Bidding Documents may be purchased and downloaded from the designated website. Prospective Bidders are urged to register with the designated website as a plan holder, even if Bidding Documents are obtained from a plan room or source other than the designated website in either electronic or paper format. 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.

The Issuing Office for the Bidding Documents is:

Turnipseed Engineers
4210 Columbia Road, Building 3, Augusta, Georgia 30907

Prospective Bidders may obtain or examine the Bidding Documents at the Issuing Office on Monday through Friday between the hours of 8:00 a.m. to 5:00 p.m. and may obtain copies of the Bidding Documents from the Issuing Office as described below. Partial sets of Bidding Documents will not be available from the Issuing Office. Neither Owner nor Engineer will be responsible for full or partial sets of Bidding Documents, including addenda, if any, obtained from sources other than the Issuing Office.

Bidding Documents may be purchased from the Issuing Office during the hours indicated above or online. Cost includes regular shipping charges. Upon Issuing Office's receipt of payment, printed Bidding Documents will be emailed and sent via regular delivery service. Bidding Documents are available for purchase in the following formats:

Format	Cost
Electronic download of Bidding Documents from https://turnipseed.com/current-projects/out-for-bid/	\$250

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.

Owner: City of Milledgeville, Georgia

By: Jacque Huley

Title: Procurement Manager

SECTION SECTION 00 21 13

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

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1.01 DEFINED TERMS

- A. 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:
 - 1. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders. **Turnipseed Engineers, 4210 Columbia Road, Building 3, Augusta, Georgia 30907**

1.02 BIDDING DOCUMENTS

- A. 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.
- B. 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.
- C. 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.

1.03 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 11 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.

- C. After the Contract is awarded, the Owner will provide or direct the Engineer to provide for the use of the Contractor documents that were developed by Engineer as part of the Project design process, as Electronic Documents in native file formats.
1. Electronic Documents that are available in native file format include:
 - a. Contract Drawings (DWG files) **These files are not available for bidding purposes.**
 2. Release of such documents will be solely for the convenience of the Contractor. No such document is a Contract Document.
 3. Unless the Contract Documents explicitly identify that such information will be available to the Successful Bidder (Contractor), nothing herein will create an obligation on the part of the Owner or Engineer to provide or create such information, and the Contractor is not entitled to rely on the availability of such information in the preparation of its Bid or pricing of the Work. In all cases, the Contractor shall take appropriate measures to verify that any electronic/digital information provided in Electronic Documents is appropriate and adequate for the Contractor's specific purposes.
 4. In no case will the Contractor be entitled to additional compensation or time for completion due to any differences between the actual Contract Documents and any related document in native file format.

1.04 QUALIFICATIONS OF BIDDERS

- A. To demonstrate Bidder's qualifications to perform the Work, after submitting its Bid and within five days of Owner's request, Bidder must submit the following information:
1. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
 2. 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.
 3. Bidder's state or other contractor license number, if applicable.
 4. Subcontractor and Supplier qualification information.
 5. Other required information regarding qualifications.
- B. Bidder is to submit the following information with its Bid to demonstrate Bidder's qualifications to perform the Work:
1. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
 2. 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.
 3. Bidder's state or other contractor license number, if applicable.
 4. Subcontractor and Supplier qualification information.

5. Other required information regarding qualifications.
 - C. A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
 - D. No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 1.05 PRE-BID CONFERENCE
- A. A pre-bid conference will not be conducted for this Project.
- 1.06 SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE
- A. Site and Other Areas
 1. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.
 - B. Existing Site Conditions
 1. Subsurface and Physical Conditions; Hazardous Environmental Conditions
 - a. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
 - 1) Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.
 - 2) 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.
 - 3) Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - 4) Technical Data contained in such reports and drawings.
 - C. ~~Owner~~ **Engineer** will make copies of reports and drawings referenced above available to any Bidder on request **for a nominal charge stated in the Advertisement for Bids**. 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.
 - D. 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.

- E. *Geotechnical Data Report*: The Bidding Documents contain a Geotechnical Data Report (GDR).
1. As set forth in the Supplementary Conditions, the GDR describes certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations
 2. The Baseline Conditions in the GDR 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 GDR, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are baselined.
 3. Nothing in the GDR 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.
- F. *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.
- G. Other Site-related Documents
1. No other Site-related documents are available.
- H. Site Visit and Testing by Bidders
1. 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.
 2. Bidders visiting the Site are required to arrange their own transportation to the Site.
 3. 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: **Todd Self or David Tyre, P.E. (augadmin@turnipseed.com) 706-863-8800**. Bidder must conduct the required Site visit during normal working hours.
 4. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- I. Owner's Safety Program
1. 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.
- J. Other Work at the Site
1. 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.

1.07 BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

A. Express Representations and Certifications in Bid Form, Agreement

1. 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.
2. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

1.08 INTERPRETATIONS AND ADDENDA

- A. Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.
- B. 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:
 1. Questions may be submitted electronically by Bidder to Engineer at augadmin@turnipseed.com.
- C. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions may not be answered.
- D. 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.

1.09 BID SECURITY

- A. A Bid must be accompanied by Bid security made payable to Owner in an amount of **Five percent (5%)** 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.
- B. 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.

- C. 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.
- D. 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.

1.10 CONTRACT TIMES

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

1.11 SUBSTITUTE AND “OR EQUAL” ITEMS

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

1.12 SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- A. **If required by the bid documents**, 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:
- B. 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.

- C. 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.
- D. The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 7.07A.
- E. The Contractor shall not be required to employ any Subcontractor, Supplier, Individual or entity against whom Contractor has reasonable objection.

1.13 PREPARATION OF BID

- A. The Bid Form is included with the Bidding Documents.
 - 1. 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.
 - 2. 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.”
- B. 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.
- C. 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 secretary or an assistant secretary.**
- D. 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.
- E. 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.
- F. A Bid by an individual must show the Bidder’s name and official address.

- G. 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.
 - H. All names must be printed in ink below the signatures.
 - I. The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
 - J. Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.
 - K. The Bid must contain evidence of Bidder's authority to do business in the state **or locality** 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.
 - L. 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.
- 1.14 BASIS OF BID
- A. Lump Sum
 - 1. Bidders must submit a Bid on a lump sum basis as set forth in the Bid Form.
 - B. Base Bid with Alternates
 - 1. 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.
 - 2. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.
 - C. Sectional Bids
 - 1. Bidders may submit a Bid on any individual section or any combination of sections, as set forth in the Bid Form.
 - 2. Submission of a Bid on any section signifies Bidder's willingness to enter into a Contract for that section alone at the price offered.
 - 3. If Bidder submits Bids on individual sections and a Bid based on a combination of those sections, such combined Bid need not be the sum of the Bids on the individual sections.
 - 4. Bidders offering a Bid on one or more sections must be capable of completing the Work covered by those sections within the time period stated in the Agreement.
 - D. Unit Price

1. 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.
2. 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.
3. 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.

E. Allowances

1. 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.

1.15 SUBMITTAL OF BID

- A. The Contractor shall submit one copy of the Bid Form Bond Form. 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..
- B. 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.
- C. **The bids must be enclosed in a sealed envelope addressed to the City of Milledgeville, (shipping and hand delivery) 119 East Hancock Street, Milledgeville, Georgia 31061 and marked “Proposal for Lamar Ham Water Treatment Plant Phase I.” Georgia Utility Contractor License must be written on the outside of the envelope.**
- D. 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.

1.16 MODIFICATION AND WITHDRAWAL OF BID

- A. 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.

- B. 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.
- C. 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.

1.17 OPENING OF BIDS

- A. 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.

1.18 BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- A. 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.

1.19 EVALUATION OF BIDS AND AWARD OF CONTRACT

- A. 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.
- B. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.
- C. 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.
- D. If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.
- E. Evaluation of Bids
 - 1. 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.
 - 2. 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.

3. For determination of the apparent low Bidder(s) when sectional bids are submitted, Bids will be compared on the basis of the aggregate of the Bids for separate sections and the Bids for combined sections that result in the lowest total amount for all of the Work.
 4. 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.
- F. 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.
- G. 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.
- 1.20 BONDS AND INSURANCE
- A. 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.
- B. Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.
- 1.21 SIGNING OF AGREEMENT
- A. 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.
- 1.22 CONTRACTS TO BE ASSIGNED – NOT APPLICABLE TO THIS CONTRACT.
- 1.23 FEDERAL REQUIREMENTS – NOT APPLICABLE TO THIS CONTACT.
- 1.24 WAGE RATE REQUIREMENTS– NOT APPLICABLE TO THIS CONTACT
- 1.25 DAVIS/BACON WAGE RATE REQUIREMENTS –NOT REQUIRED FOR THIS CONTRACT
- 1.26 GEORGIA SECURITY AND IMMIGRATION COMPLIANCE
- A. The Contractor and subcontractor are required to execute affidavits (included in contract documents) verifying the work eligibility of all newly hired employees.
- 1.27 NON-COLLUSION AFFIDAVIT
- A. The Bidder must complete the Non-Collusion Affidavit (NCA-1) with their Bid.

1.28 MISCELLANEOUS ITEMS

1. Material and Work by the Owner: The Owner will neither furnish materials nor perform labor for construction of work under this contract, unless otherwise stipulated elsewhere in the Project Documents.
2. Extra Work Items in Proposal: The Proposal contains certain unit price items entitled “Extra Work If Ordered by Engineer.” In each of those items, the estimated quantity is based upon the average amount of extra work encountered in a typical job. The stated quantities are not guaranteed to be required or not to be required, but are included in the Proposal in order to determine, in advance of construction, the actual low bidder. No work described by those items will be approved for payment without advance authorization by the Engineer.
3. Notice of Special Conditions: Attention is particularly called to those parts of the Contract Documents and Specifications which deal with the following:
 - a. Inspection and testing of material
 - b. Insurance requirements
 - c. Wage rates (if applicable)
 - d. Work within railroad right of way (if applicable)
4. Sanitary Provision: The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the regulation of the State Board of Health and all local ordinances. No nuisance will be permitted.
5. Power of Attorney: Attorneys-in-fact who sign Bid Bonds or Contract Bonds must file with each bond a certified and effectively dated copy of their Power of Attorney
6. Social Security Tax and Sales Tax: The Contractor assumes and is liable specifically for all State and Federal so-called Payroll or Social Security Taxes and for all State and Federal Sales and Use Taxes that may be in force at the time of the award of the Contract, and guarantees to hold the Owner harmless in every respect against same.
7. Use of Premises: The Contractor shall not load nor permit any part of any structure to be loaded with a weight which will endanger its safety. The Contractor shall confine his apparatus; the storage of materials and the operations of his workmen to the limits defined by laws, ordinance, permits or directions of the Engineer and shall not unduly encumber the premises with his material.
8. The Contractor shall enforce the instructions of the Engineer regarding signs, advertisements, fire and smoking.
9. Guards, Lights, Etc.: The Contractor shall provide all barricades, guards, lights or other such protection and walks around his work as are required by the regulation of State County or Federal laws and shall assume all responsibility of same, and keep them in repair. The necessary lighting, if required, to facilitate overtime work shall be provided. All barricades, etc. shall be promptly removed on completion of the work.

10. Moving Materials: If it becomes necessary at any time during the construction to move materials which are to enter into the construction, the materials having been temporarily placed, the Contractor or subcontractor shall, when so directed by the Engineer, move them or cause them to be moved without additional cost to the Owner.
11. Cleaning During Construction and at Completion of Work: The General Contractor shall keep the premises clean at all times and shall remove all rubbish as often as directed by the Resident Inspector or Owner. If the Contractor does not at all times provide men to attend to the cleaning up, on request, in a manner satisfactory to the Resident Inspector, the Resident Inspector may employ such men to direct and charge the cost of same to the account of the Contractor. Every effort shall be made to minimize siltation and bank erosion during construction.
12. Upon completion of the work, the Contractor shall leave the grounds in a neat and clean condition. Construction areas shall be replanted with grass and shrubs where they have been removed, and where necessary at the request of the Engineer, the ground shall be sprigged or sodded. All areas disturbed by construction shall be restored to present or better condition. Any existing structure which is damaged during construction shall be repaired or replaced to original condition at the Contractor's expense.
13. Removal of Materials: All materials of unsound or otherwise unfit character and not in accordance with the terms of the Contract will be condemned by the Engineer.
14. The Contractor shall promptly remove from the premises all condemned materials whether incorporated in the work or not. The Contractor shall promptly replace the materials to the satisfaction of the Engineer. If the Contractor does not remove such condemned materials within a reasonable time, fixed by written notice, the Owner may remove them and store at the expense of the Contractor. If the Contractor does not pay to the Owner the expense of such removal within ten (10) days time thereafter, the Owner may upon ten (10) days written notice sell such materials at auction or private sale and shall account for the net proceeds thereof, after deduction of all cost and expenses that rightfully should have been borne by the Contractor.
15. Maintenance: The Contractor will be required to maintain all work done by him in a first class condition for thirty (30) days after the same has been completed as a whole and the Engineers have notified the Contractor in writing that the work has been finished to their satisfaction. The retained percentage will not be due or payable to the Contractor until the thirty (30) day maintenance period has expired.
16. Any damage to the site or surroundings, including paving, shoulders, culverts, drainage structures, grass, etc., shall be repaired by the Contractor and all parts of the site shall be left in as good repair as before the work started.
17. Quantities of Estimate: The estimated quantities of work to be done and materials to be furnished under this contract shown in any of the documents, including the proposal, are given for use in comparing bids and to indicate approximately the total amount of the contract. The right is especially reserved, except as herein otherwise specifically limited, to increase or diminish them as may be deemed reasonably necessary or desired by the Owner to complete the work contemplated by this contract.
18. Public Convenience and Safety: No street, alley or other roadway shall be closed to the public by the Contractor, except by written permission of the Engineer, and except while so

closed, the Contractor shall maintain traffic over, through or around work, with the maximum practical convenience for the full 24 hours of each day, whether or not work has ceased temporarily. The Contractor shall notify the Engineer in writing at the earliest practicable date and in any case before starting any construction that might in any way inconvenience or endanger traffic, regarding each proposed closure and proposed schedule of operations thereon, so that all necessary arrangements may be made.

19. The convenience of the general public and of residents along the working area shall be provided for in a reasonably adequate and satisfactory manner. Where existing roadways are not available for use as detours, traffic shall be permitted to pass through the work, except as otherwise specified or directed by the Engineer. The Contractor shall provide and maintain at his expense and in a manner approved and deemed practicable by the Engineer such temporary roads as may be necessary to provide convenience access to driveways, houses, buildings, business establishments and other property abutting the work, as well as temporary approaches to and crossings of, intersecting streets and other roadways. The Contractor shall provide at his expense temporary bridges for pedestrians, as required, at all street intersections over ditches, etc.
20. Materials and equipment, stored along streets and other roadways, shall be so placed and the work at all times shall be conducted as to insure minimum danger and obstruction to the traveling public.
21. Fire hydrants in operating condition shall be accessible at all times to the Fire Department. No material or other obstructions shall be placed closer to an operating fire hydrant than permitted by ordinances, rules or regulations. No operating fire hydrant shall be disconnected, removed or otherwise rendered inoperable without the written permission of the Fire Department.
22. The Contractor shall give the Owner at least 24 hours' notice in writing before closure of each street and each street intersection.
23. Public Utilities: The Contractor will be held responsible for the protection of the property and services of public utilities within the limits of the work. Where such physical properties conflict with the performance of the work under the Contract, he shall anticipate such conflicts and give proper advance written notice thereof to the owners of the utilities involved. Until satisfactory arrangements are made for continuance of service, the Contractor shall not commence any operations, which may interfere with or impair the efficiency of the existing physical properties.
24. Unless otherwise specified or approved, utility lines shall be maintained in continuous service, and shall be properly supported and protected by the Contractor.
25. In no case shall interruption to water or sewer service be allowed to exist outside of working hours, except as permitted by the Engineer on the pipe lines to be altered or replaced under this Contract. Operating fire hydrants shall be kept accessible to the Fire Department at all times, and the hydrants shall be kept clear of excavated materials and other materials, as specified in these Specifications.
26. In the event of interruption to water or other utility services as a result of accidental breakage, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service as promptly as practicable. In the event that such pipes or other facilities are broken or improperly supported, the Contractor will be held responsible

for their complete and prompt restoration in substantial and workmanlike manner, and for any claim for damage, which may arise as a result of such interruption of service.

27. Maintenance During Construction: The Contractor shall maintain at his expense the work during construction and until final acceptance of all work under the Contract. Continuous and effective work shall be prosecuted day by day, with adequate equipment and forces as required to keep the backfill, pavement, structures, pipe lines and other features in satisfactory and acceptable condition at all times.
28. In the event that the Contractor fails to remedy any unsatisfactory maintenance, within 24 hours after receipt of written notice from Engineer describing the unsatisfactory conditions, the Owner may immediately proceed with adequate forces and equipment to maintain the project, and the entire cost of this maintenance will be deducted from the monies otherwise due the Contractor under the Contract. As an alternative to the above specified maintenance, all of the items which are not properly maintained may be deducted at the Contract prices from the current partial payment estimate even if such items have been paid for in previous estimates.
29. Errors and Omissions: The Contractor shall take no advantage of any apparent error or omission in the Drawings or Specifications; but if such error or omission does occur, the Engineer shall have the authority to make corrections and interpretations deemed necessary to fulfill the intent of the Drawings and Specifications. Nor shall such corrections or interpretations, if any, be construed as a waiver of any Contract provision.
30. Should any portions of the Drawings and Specifications be obscure or in dispute, they shall be referred to the Engineer and he shall decide as to the true meaning and intent. He shall also have the right to correct any errors or omissions at any time when such corrections are necessary for the proper fulfillment of said Drawings and Specifications.
31. Use of Chemicals: All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either APA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.
32. Cooperation of Contractor: The Contractor shall have available on the work, at all times, one (1) copy of each of said Drawings and Specifications. He shall give the work the constant attention necessary to facilitate the progress thereof and shall cooperate with the Engineer and with other contractors in every way possible. The Contractor shall at all times have a Superintendent, satisfactory to the Engineer, capable of acting as his agent on the work, who shall receive instructions from the Engineer or his authorized representatives. The superintendent shall have full authority to execute the orders or directions of the Engineer without delay and to promptly supply such materials, tools plant equipment, and labor as may be required.
33. Construction Stakes: Subsidiary lines and grades shall be laid out by the Contractor from the controlling lines and benchmarks furnished by the Engineer or from measurements shown on the Drawings. All lines and grades shall be subject to checking by the Engineer, but this checking shall in no way relieve the Contractor from responsibility for their correctness.

34. The Contractor shall provide such stakes, materials, and such labor and assistance as the Engineer may require in laying out work, establishing benchmarks and checking and measuring the work.
35. Resident Inspector: The Resident Inspector as the Engineer's representative on the project, shall assist and advise the Contractor as to interpretation of the Drawings and Specifications. Inspectors shall be authorized to inspect all work done and materials furnished, including preparation, fabrication and manufacture of the materials to be used. The Inspector shall not be authorized to alter or waive any requirements of the Specifications. He shall call the attention of the Contractor to any failure of the work or materials to conform to the Specifications and Contract. He may reject materials or suspend the work until any questions at issue can be referred to and decided by the Engineer.
36. The presence of the Inspector shall in no way lessen the responsibility of the Contractor. The Contractor in no way relieves himself of responsibility for adequacy of the work by following the directives of the Inspector.
37. Inspection: The Contractor shall furnish the Engineer with every reasonable facility for ascertaining whether or not the work performed and materials used are in accordance with the requirements and intent of the Specifications and Contract. No work shall be done or materials used without suitable supervision or inspection by the Engineer or his representative. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered, or obligate the Owner to final acceptance.
38. All materials furnished and work done when not in accordance with the Specifications and Contract will be rejected and shall immediately be removed and other work done and materials furnished in accordance therewith. If the Contractor fails to remove the work and materials as above ordered, within 48 hours, then the Engineer shall have the right and authority to stop the Contractor and his work at once and to supply men and material at the cost and expense of the Contractor to remove said work and materials.
39. Defective Work and Materials: The inspection of the work shall not relieve the Contractor of any of his obligations to fulfill his Contract and defective work shall be made good, notwithstanding that such work and materials have been previously inspected by the Engineer and accepted or estimated for payment. The failure of the Engineer to condemn improper materials or workmanship shall not be considered as a waiver of any defect which may be discovered later, or as preventing the Owner at any time subsequently from recovering damages for work actually defective. All work shall be guaranteed against defects in workmanship or materials for a period of one year after final acceptance.
40. Disagreement: Should any disagreement or difference arise as to the estimated quantities or classifications or as to the meaning of the Drawings or Specifications, on any point concerning the character, acceptability and nature of the several kinds of work, any materials and construction thereof, the decisions of the Engineer shall be final and conclusive and binding upon all parties to the Contract.
41. Weather: During unseasonable weather, all work must stop when the Engineer so directs, and all work must be suitably protected.
42. Right of Way: The necessary land for the construction of the work will be furnished by the Owner. The Contractor is directed to the Owner for right of way actually acquired. The Owner will provide no right of way over other property. The Contractor shall take every

possible precaution to inconvenience as little as possible the owners and tenants of adjacent property. Public highways shall not be obstructed in such a way as to cut off traffic. The Contractor shall, at his own expense, repair any damage or injury to either public or private property during the progress of the work. Wholesale cutting of trees on the right of way will not be permitted except as necessary for construction.

43. Construction Schedule: A construction schedule showing the work in the order proposed by the Contractor and the time required to complete each phase will be required and shall be submitted to the Engineer at the preconstruction conference. Acceptance of the construction schedule is required prior to receipt of the notice to proceed. This schedule shall include the dates for beginning and completion of all phases of the work. If, in the opinion of the Engineer, the Contractor falls behind in his schedule or will not be able to complete the project in the time limits, he may require the Contractor to revise his schedule and put additional equipment on the job as so ordered.
44. Order of Work: The order or sequence of the work shall be as provided herein, which shall in no way affect the responsibility of the Contractor.
45. Work Hours: Approved hours of work are Monday through Friday, 7:00 a.m. to 7:00 p.m., unless approved in writing by Owner / Engineer.
46. Competent Labor: The Contractor shall employ only competent and skilled workers on the Project. The Contractor shall have a competent Superintendent present at all times when the work is in progress with authority to receive orders and execute the work.
47. The Contractor shall, upon demand from the Engineer, immediately remove any Superintendent, Foreman or Workman whom the Engineer may consider incompetent or undesirable.
48. Laws and Regulations: The Contractor shall keep himself fully informed of all laws, ordinances and regulations of State and County in any manner affecting those engaged or employed in the work, or the materials used in the work, or in any way affecting the conduct of the work, and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same. If any discrepancy or inconsistency should be discovered in this Contract, or in the Drawings or Specifications herein referred to, in relation to any such law, ordinance, regulation, order or decree, he shall forthwith report the same in writing to the Owner. He shall at all times himself observe and comply with all such existing and future laws, ordinances and regulations, and shall protect and indemnify the Owner and its agents against any claims or liability arising from or based on the violation of any such law, ordinance, regulation, order of decree, whether by himself or by his employees.
49. Protective Works: The Contractor shall furnish and install all necessary temporary works for the protection of the work, including barricades, warning signs and lights at night.
50. Sanitary Regulations: Necessary sanitary conveniences for the use of the laborers on the work shall be erected and maintained by the Contractor in such a manner and at such points as shall be discussed by the Engineer. Their use shall be strictly enforced.
51. Storage Facilities: Should the Contractor so desire, he may build storage facilities or other structures for housing men, tools, machinery and supplies, but they will be permitted only at approved places, and their surroundings shall be maintained at all times in a sanitary and

satisfactory manner. On or before the completion of the work, all such structures shall be removed, together with all rubbish and trash, at the expense of the Contractor.

52. Soil Erosion and Sediment Control: The Contractor shall be required to take the necessary steps to minimize siltation and soil erosion during construction. The Contractor shall utilize best management practices (BMPs) as shown and in accordance with the Manual for Erosion and Sediment Control in Georgia, as amended to date.
53. Georgia Water Quality Control Act: According to the Rules and Regulations of the Georgia Water Quality Control Act, Chapter 391-3-6, Section 12-5-51, anyone who intentionally or negligently causes or permits raw wastewater to discharge into State waters or onto the ground may be held liable for damages to the State.
54. Safety and OSHA Regulations: The performance of work under this Contract shall comply with safety regulations prescribed by the Owner, those of the National Occupational Safety and Health Act of 1970 as amended to date (PL 91-596), and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-054), and the requirements of the State where project is located. Each bidder shall satisfy himself as to the character and extent of such regulations.
55. Stormwater Monitoring: If required, the Contractor shall measure rainfall and perform inspections and sample discharges in accordance with NPDES Storm Water Discharges Associated with Construction Activities, General Permit (GAR 100001, 100002, 100003).
56. Access Roads: Streets, roads and drives used by the Contractor for access to and from the site of his work shall be protected from damage in connection with construction work. Any such damage done shall be repaired immediately and left in good condition at the end of the construction period.
57. Contractor's Local Office: The Contractor shall maintain a local office with a telephone in the general area of the work, and will be required to have a responsible representative on call at all times.
58. Office Space and Facilities for Inspectors: The Contractor shall furnish proper and adequate office space and facilities for the use of the Inspectors. A separate room shall be provided at least 12' x 14' either in connection with the Contractor's office or in a separate structure, equipped with lights, heat, air conditioning, desk, chair, file cabinet, plan rack and plan table. All costs in connection with furnishing of utilities for the Resident Inspector shall be paid by the Contractor.
59. Mutual Responsibilities of Contractor: If, through acts of neglect of the part of the Contractor, any other Contractor or any subcontractor shall suffer loss or damage on the work, the Contractor agrees to settle with such other Contractor or subcontractor by agreement of arbitration if such other Contractor or subcontractor shall assert any claims against the Owner, on account of any damage alleged to have been so sustained, the Owner shall notify the Contractor who shall indemnify and save harmless the Owner against such claim.
60. Emergency Work: The Contractor shall at all times, including nights, weekends or holidays, have a responsible man available to act in case of emergency repairs who the Owner may contact. Upon notification of emergency work necessary, the Contractor's representative shall immediately take steps to make such repairs.

61. Flood Hazard Insurance: If applicable, the Contractor will be required to acquire and maintain during the life of the contract any flood insurance made available under the National Flood Insurance Act of 1968, as amended. The insurance shall be in an amount at least equal to the contract amount costs, excluding cost of uninsurable improvements, or to the maximum limit of coverage made available under the National Flood Insurance Act of 1968, as amended, whichever is less.
62. Building Permits and Business License: The Contractor shall be required to obtain applicable Building Permits and Business Licenses as required by the City of Milledgeville or Baldwin County, Georgia.
63. Construction Permits, Easements and Right of Way: All construction permits, and easements or right of ways known to be required to begin construction have been obtained with the following exception: *None*.

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.

1.01 OWNER AND BIDDER

- A. This Bid is submitted to: City of Milledgeville, Georgia, 119 East Hancock Street, Milledgeville, Georgia, 31061
- B. 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.

1.02 ATTACHMENTS TO THIS BID

- A. The following documents are submitted with and made a condition of this Bid:
 - 1. Required Bid security;
 - 2. List of Proposed Subcontractors;
 - 3. List of Proposed Suppliers;
 - 4. 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;
 - 5. 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;
 - ~~6.~~ Required Bidder Qualification Statement with supporting data; and
 - 7. Non-Collusion Affidavit

1.03 BASIS OF BID—LUMP SUM BID AND UNIT PRICES

- A. Lump Sum Bids
 - 1. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum (stipulated) price(s), together with any Unit Prices ~~indicated in Paragraph 3.02 as follows on the proposal form:~~
- B. Unit Price Bids
 - 1. Bidder will perform the following Work at the indicated unit prices **as shown on the proposal form.**
 - 2. Bidder acknowledges that:
 - a. 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

- b. 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.

C. Total Bid Price (Lump Sum and Unit Prices) **is listed on previous Bid Form pages**

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

1.04 TIME OF COMPLETION

- A. 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.
- B. Bidder accepts the provisions of the Agreement as to liquidated damages.

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

A. Bid Acceptance Period

1. 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.

B. Instructions to Bidders

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

C. Receipt of Addenda

1. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

1.06 BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

A. Bidder's Representations

1. In submitting this Bid, Bidder represents the following:
 - a. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
 - b. 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.

- c. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
- d. 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.
- e. 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.
- f. 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.
- g. 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.
- h. 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.
- i. 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.
- j. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- k. 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.
- l. **Bidder will submit written evidence of its authority to do business in the State or other jurisdiction where the Project is located no later than the date of its execution of the Agreement.**
- m. **The bidder further proposes and agrees hereby to commence work under contract, with adequate force and equipment, on a date to be specified in a written order of the Engineer, and shall fully complete all work thereunder**

within the following number of consecutive calendar days set forth in the Agreement Between Owner and Contractor for Construction Contract.

B. Bidder's Certifications

1. The Bidder certifies the following:
 - a. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
 - b. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
 - c. Bidder has not solicited or induced any individual or entity to refrain from bidding.
 - d. 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:
 - 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.
 - 2) Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
 - 3) Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
 - 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.

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)

CITY OF MILLEDGEVILLE, GEORGIA
LAMAR HAM WATER TREATMENT PLANT IMPROVEMENTS
CONTRACT I - ADDITIONS TO THE WATER TREATMENT PLANT

For furnishing all materials and equipment and performing all labor necessary for the modifications to the Lamar Ham Water Treatment Plant as shown on the Drawings and as specified for the following prices and approximate quantities shown.

Item 1:

For furnishing all materials and equipment and performing all labor necessary for construction of the Water Treatment Plant Improvements, including grading, site works, erosion control, demolition, renovation, excavation, backfill, structures, piping, drains, and appurtenances, electrical, mechanical (excluding cost of Major Mechanical Equipment listed in Item 2), painting, and all other work and appurtenances for completion of work as shown on the Drawings and/or specified, the lump sum of:

	DOLLARS (\$ _____)

Item 2: MECHANICAL EQUIPMENT

Equipment and Manufacturer	Price	Base Price
a. Vertical Turbine (High Service) Pumps (Section 43 24 13)		
Mfr. Floway		
Mfr. Peerless		
Mfr. _____		
b. Remineralization System (Seciton 46 31 43)		
Mfr. Burnett Lime Company		
Mfr. _____		
c. Chemical Metering Pumps (Section 46 33 00)		
Mfr. Grundfos		
Mfr. Watson Marlowe		
Mfr. _____		
Mfr. _____		

SUBTOTAL, ITEM 2 INCLUSIVE, THE AMOUNT OF: _____

EXISTING CONCRETE REHABILITATION

ITEM NO.	QTY.	UNIT DESCRIPTION	UNIT PRICE	TOTAL PRICE
Item 3. CONCRETE REHABILITATION (Section 03 01 30)				
a.	36	SF Minor Spall Repair		
b.	24	SF Intermediate Spall Repair		
c.	12	CF Major Spall Repair		
d.	35	LF Crack Repair		

SUBTOTAL, ITEMS 3 INCLUSIVE, THE AMOUNT OF: _____

BID ALLOWANCES

NO.	QTY.	UNIT	DESCRIPTION	PRICE	PRICE
4.	1	LS	SCADA Allowance (Section 25 00 00)	\$30,000.00	\$30,000.00
5.	1	LS	Landscaping and Irrigation Allowance (Section 32 92 00)	\$150,000.00	\$150,000.00
6.	1	LS	Laboratory Equipment Allowance (Section 11 53 00)	\$50,000.00	\$50,000.00
7.	1	LS	Office Furniture Allowance (Section 12 50 00)	\$75,000.00	\$75,000.00

SUBTOTAL, ITEMS 4 - 7 INCLUSIVE, THE AMOUNT OF: \$275,000.00

EXTRA WORK, IF ORDERED BY ENGINEER**ITEM**

NO.	QTY.	UNIT	DESCRIPTION		
8.			EXCAVATION & BACKFILL		
a.	10 CY		Hand, Dry		
b.	10 CY		Hand, Wet and Dewatering		
c.	10 CY		Machine, Dry		
d.	10 CY		Machine, Wet and Dewatering		
e.	300 CY		Crusher Run Stone Backfill		
9.			CONCRETE WORK		
a.	10 CY		Class "A" Concrete		
b.	10 CY		Class "B" Concrete		
c.	10 CY		Class "C" Concrete		
10.			PLANT SEWER LINES		
a.	100 LF		6" D.I. Pipe		
b.	1 EA		Manhole, Complete with Base Riser, Cone, Lid, 0-8 Ft.		
c.	10 LF		Manhole, Additional Depth		

TOTAL AMOUNT BID, ITEMS 1 THROUGH 13, INCLUSIVE, THE AMOUNT OF: _____

_____ **DOLLARS (\$ _____)**

ADDITIONS/DEDUCTIONS

The owner reserves the right to make certain adjustments to the base bid utilizing the following deductions/ additions. Award of the contract may be with one or more of these items. Each bidder must fill in the amount as required below.

D-1 If awarded Ceramic Membrane Pilot Contract 2 deduct \$_____ from the lump sum price.

ITEM**NO. QTY. UNIT DESCRIPTION****SUBSTITUTE EQUIPMENT**

The Bidder may offer at his own option the bid price and name of other makes of equipment which he desires to substitute for specified equipment designated by him in Parts 1 and 2, Item 2 of the Proposal. The Bidder is referred to Section 10.03 of these specifications for "Substitute Equipment" required.

Item	Equipment & Manufacturer	Price	Base Price
_____	Mfr. _____	_____	_____
_____	Mfr. _____	_____	_____

NOTE: The Owner reserves the right to select any item of equipment bid upon as a basis to award contract.

The Bidder further proposes and agrees hereby to commence work under contract, with adequate force and equipment, on a date to be specified in a written order of the Engineer, and shall fully complete all work thereunder within the number of consecutive calendar days setforth in the Contract Agreement.

CITY OF MILLEDGEVILLE, GEORGIA
LAMAR HAM WATER TREATMENT PLANT IMPROVEMENTS
CONTRACT II - CERAMIC MEMBRANE PILOT

For furnishing all materials and equipment and performing all labor necessary to install the full scale pilot at the Lamar Ham Water Treatment Plant as shown on the Drawings and as specified for the following prices and approximate quantities shown.

Item 1:

For furnishing all materials and equipment and performing all labor necessary for construction of the Full Scale Pilot, including site works, erosion control, demolition, renovation, excavation, backfill, structures, piping, drains, and appurtenances, electrical, mechanical (excluding cost of Major Mechanical Equipment listed in Item 2), painting, and all other work and appurtenances for completion of work as shown on the Drawings and/or specified, the lump sum of:

	DOLLARS (\$)

Item 2: MECHANICAL EQUIPMENT

Equipment and Manufacturer		Price	Base Price
a. Membrane Filtration Equipment			
Mfr.	Cerrefiltec		
Mfr.	Ovivo		
Mfr.			

SUBTOTAL, ITEM 2 INCLUSIVE, THE AMOUNT OF:

BID ALLOWANCES

NO.	QTY.	UNIT	DESCRIPTION	PRICE	PRICE
3.	1	LS	SCADA Allowance	\$30,000.00	\$30,000.00

EXTRA WORK, IF ORDERED BY ENGINEER

ITEM

NO.	QTY.	UNIT	DESCRIPTION

TOTAL AMOUNT BID, ITEMS 1 THROUGH 3, INCLUSIVE, THE AMOUNT OF:

	DOLLARS (\$)

ADDITIONS/DEDUCTIONS

The owner reserves the right to make certain adjustments to the base bid utilizing the following deductions/ additions. Award of the contract may be with one or more of these items. Each bidder must fill in the amount as required below.

ITEM**NO. QTY. UNIT DESCRIPTION**

D-1 If awarded Water Treatment Plant Improvements Contract 1 deduct \$_____ from the lump sum price.

SUBSTITUTE EQUIPMENT

The Bidder may offer at his own option the bid price and name of other makes of equipment which he desires to substitute for specified equipment designated by him in Parts 1 and 2, Item 2 of the Proposal. The Bidder is referred to Section 10.03 of these specifications for "Substitute Equipment" required.

Item	Equipment & Manufacturer	Price	Base Price
_____	Mfr. _____	_____	_____
_____	Mfr. _____	_____	_____

NOTE: The Owner reserves the right to select any item of equipment bid upon as a basis to award contract.

The Bidder further proposes and agrees hereby to commence work under contract, with adequate force and equipment, on a date to be specified in a written order of the Engineer, and shall fully complete all work thereunder within the number of consecutive calendar days setforth in the Contract Agreement.

SECTION 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: City of Milledgeville, Georgia Address (<i>principal place of business</i>): 119 East Hancock Street Milledgeville, Georgia 31061	Bid Project (<i>name and location</i>): City of Milledgeville, Georgia Lamar Ham Water Treatment Plant Improvements, August 2025 Project Number: 262645 Bid Due Date:
Bond Penal Sum: Date of Bond:	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder	Surety
By: _____ <i>(Full formal name of Bidder)</i>	By: _____ <i>(Full formal name of Surety) (corporate seal)</i>
Name: _____ <i>(Signature)</i>	Name: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i>	

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

statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.

11. The term “Bid” as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 45 13**QUALIFICATIONS STATEMENT****1.01 GENERAL INFORMATION****A. Provide contact information for the Business:**

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

B. Provide information on the Business's organizational structure:

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

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

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

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

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

1.02 LICENSING

- A. Provide information regarding licensure for Business:

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

1.03 DIVERSE BUSINESS CERTIFICATIONS

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

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

1.04 SAFETY

- A. Provide information regarding Business's safety organization and safety performance.

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

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

Year									
Company	EMR	TRFR	MH	EMR	TRFR	MH	EMR	TRFR	MH

1.05 FINANCIAL

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

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

1.06 SURETY INFORMATION

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

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

1.07 INSURANCE

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

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

1.08 CONSTRUCTION EXPERIENCE

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

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

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

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

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

1.09 REQUIRED ATTACHMENTS

- A. Provide the following information with the Statement of Qualifications:

1. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.
2. Diverse Business Certifications if required by Paragraph 3.01.
3. Certification of Business's safety performance if required by Paragraph 4.02.
4. Financial statements as required by Paragraph 5.01.

5. Attachments providing additional information as required by Paragraph 8.02.
6. Schedule A (Current Projects) as required by Paragraph 8.03.
7. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 8.04.
8. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 8.05.
9. Additional items as pertinent.

This Statement of Qualifications is offered by:

Business:

(typed or printed name of organization)

By:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Date:

(date signed)

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

Attest:

(individual's signature)

Name:

(typed or printed)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

Schedule A—Current Projects

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

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

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

Schedule B—Previous Experience with Similar Projects

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

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

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

Schedule B—Previous Experience with Similar Projects

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

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

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

Schedule C—Key Individuals

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

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

SECTION 00 45 19

NON-COLLUSION AFFIDAVIT OF BIDDER

State of _____

County of _____

I, _____ (name of individual), being first duly sworn, deposes and says that:

- (1) He is _____ (title) of _____ (Company) the Bidder that has submitted the Bid on the following:

**CITY OF MILLEDGEVILLE, GEORGIA
LAMAR HAM WATER TREATMENT PLANT IMPROVEMENTS
AUGUST 2025**

- (2) He makes an oath that O.C.G.A. 36-91-21 (e) has not directly or indirectly been violated;
- (3) Such Bid is genuine and is not a collusive or sham Bid;
- (4) Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees, or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid of any other bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the City of Milledgeville, Georgia or any person interested in the proposed Contract; and
- (5) The price or prices quoted in the attached Bid are fair and proper and not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

(Signed) _____

Title _____

Subscribed and sworn to before me,

This _____ day of _____, 2025

Notary Public: _____

(Notary Seal)

My commission expires: _____

SECTION 00 51 00

NOTICE OF AWARD

Date of Issuance:

Owner: **City of Milledgeville, Georgia**

Owner's Project No.:

Engineer: **Turnipseed Engineers**

Engineer's Project No.: **232645**

Project: **Lamar Ham Water Treatment Plant Improvements**

Contract Name:

Bidder:

Bidder's

You are notified that Owner has accepted your Bid dated _____ for the above Contract, and that you are the Successful Bidder and are awarded a Contract for: **construction of the Lamar Ham Water Treatment Plant Improvements, as described in the contract specifications and drawings**

The Contract Price of the awarded Contract is \$_____ 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.

Six 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 **Six** 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): **Not Applicable**

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: **City of Milledgeville, Georgia**

By (signature): _____

Name (printed): _____

Title: _____

Copy: **Turnipseed Engineers**

EJCDC® C-510, Notice of Award.

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SECTION 00 52 00

AGREEMENT BETWEEN OWNER AND CONTRACTOR

SECTION FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between the City of Milledgeville, Georgia (“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:

1.01 WORK

- A. Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:
 - 1. Contract I: Additions to the existing water treatment plant including construction of a new Control Building, Chemical Feed Systems and Structures, Rapid Mix Structures, Clearwell, and High Service Pump Station, along with all related building, site, piping, electrical and other associated modifications.
 - 2. Contract II: Additions to the existing water treatment plant including construction of a new Full Scale Pilot filtration system, including demolition, renovation, excavation, backfill, structures, piping, drains, and appurtenances, electrical, mechanical and other associated modifications.

1.02 THE PROJECT

- A. The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Furnishing all materials, equipment, and labor for the construction of the City of Milledgeville, Georgia, Lamar Ham Water Treatment Improvements, August 2025

1.03 ENGINEER

- A. The Owner has retained **Turnipseed Engineers** (“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.
- B. The part of the Project that pertains to the Work has been designed by **Engineer**.

1.04 CONTRACT TIMES

- A. Time is of the Essence
 - 1. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- B. Contract Times: Days
 - 1. Contract I: The Work will be substantially complete within **540** 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 **570** days after the date when the Contract Times commence to run

2. Contract II: The Work will be substantially complete within **270** 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 **300** days after the date when the Contract Times commence to run.

C. Liquidated Damages

1. 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):
 - a. *Substantial Completion:* Contractor shall pay Owner **\$600.00** 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.
 - b. *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 **\$600.00** for each day that expires after such time until the Work is completed and ready for final payment.
 - c. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
2. 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.

D. Special Damages

1. 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.
2. 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.

3. The special damages imposed in this paragraph are supplemental to any liquidated damages for delayed completion established in this Agreement.

1.05 CONTRACT PRICE

- A. 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:
 1. For all Work other than Unit Price Work, a lump sum of **\$[number]**.
 2. Total of Lump Sum Amount and Unit Price Work (subject to final Unit Price adjustment) **\$[number]**.
 3. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

1.06 PAYMENT PROCEDURES

A. Submittal and Processing of Payments

1. 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.

B. Progress Payments; Retainage

1. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the **25th** day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
 - a. 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.
 - 1) **95** percent of the value of the Work completed (with the balance being retainage).
 - b. **95** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
2. Upon Substantial Completion **of the entire construction to be provided under the construction Contract Documents**, Owner shall pay an amount sufficient to increase total payments to Contractor to **100** percent **of all parts of this contract**, 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.

C. Final Payment

1. 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.

D. Consent of Surety

1. 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.

E. Interest

1. All amounts not paid when due will bear interest at the lesser of rates provided either by state law or by the current market for short term lending.

PART 2 - CONTRACT DOCUMENTS

A. 7.01 Contents

1. A. The Contract Documents consist of all of the following:
 - a. This Agreement.
 - b. Bonds:
 - 1) Performance bond (together with power of attorney).
 - 2) Payment bond (together with power of attorney).
 - c. General Conditions.
 - d. Supplementary Conditions.
 - e. Specifications as listed in the table of contents of the project manual (copy of list attached).
 - f. Drawings (not attached but incorporated by reference) consisting of **[number]** sheets with each sheet bearing the following general title: **City of Milledgeville, Georgia, Lamar Ham Water Treatment Plant Improvements, August 2025**
 - g. Addenda (numbers **[number]** to **[number]**, inclusive).
 - h. Exhibits to this Agreement (enumerated as follows):
 - 1) Contractor's Bid, Section 00 41 00 (C-410)
 - 2) Non-Collusion Affidavit, Section 00 45 19
 - 3) Contractor Affidavit and Agreement, Section 00 54 51
 - 4) Subcontractor Affidavit, Section 00 54 53
 - 5) Affidavit Verifying Status of Public Benefit, Section 00 54 55
 - 6) Project Bonds, Section 00 61 13.13 and 00 61 13.16
 - i. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - 1) Notice to Proceed.

- j. Work Change Directives.
 - k. Change Orders.
 - l. Field Orders.
 - m. Warranty Bond, if any.
- 2. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).
 - 3. There are no Contract Documents other than those listed above in this Article 7.
 - 4. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

2.02 REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

A. Contractor's Representations

- 1. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 - a. Contractor has examined and carefully studied the Contract Documents, including Addenda.
 - b. 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.
 - c. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - d. Contractor has carefully studied ~~the~~ **any and all** 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.
 - e. Contractor has carefully studied ~~the~~ **any and all** 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. **The prospective bidder must form his own opinion of the character of the subsurface materials encountered in excavating for construction of the various facilities.**
 - f. 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.

- g. 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.
- 2. 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.
- 3. 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.
- 4. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- 5. 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.

B. Contractor's Certifications

- 1. 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:
 - 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 or in the Contract execution;
 - b. "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;
 - 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; and
 - 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.

C. Standard General Conditions

- 1. 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 _____ (which is the Effective Date of the Contract).

City of Milledgeville, Georgia

Contractor:

Contract:

(typed or printed name of organization)

(typed or printed name of organization)

By: _____
(individual's signature)

By: _____
(individual's signature)

Date: _____
(date signed)

Date: _____
(date signed)

Name: _____
(typed or printed)

Name: _____
(typed or printed)

Title: _____
(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)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

Address for giving notices:

Designated Representative:

Designated Representative:

Name: _____
(typed or printed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Address:

Phone: _____

Phone: _____

Email: _____

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.)

License No.: _____
(where applicable)

State: _____

SECTION 00 54 51
CONTRACTOR AFFIDAVIT AND AGREEMENT

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is contracting with City of Milledgeville, Georgia has registered with, is authorized to use and is participating in a federal work authorization program* [any of the electronic verification work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91. The user identification number and the date of authorization for the affiant are set forth below. The undersigned contractor is using and will continue to use the federal work authorization program throughout the contract period.

The undersigned further agrees that, should it employ or contract with any subcontractor(s) in connection with the physical performance of services pursuant to this contract with City of Milledgeville, Georgia, that undersigned shall require as a condition of such employment or contract that contractor or subcontractor registers and participates in a federal work authorization program to verify information of all newly hired employees. In addition, contractor will secure from such contractor(s) or subcontractor(s) similar verification of compliance with O.C.G.A. 13-10-91 on the Subcontractor Affidavit provided in Rule 300-10-01-.08 or a substantially similar form. Contractor further agrees to maintain records of such compliance and provide a notice of identity of such contractor or subcontractor together with a copy of each such verification to City of Milledgeville, Georgia within five (5) business days after the time the contractor(s) or subcontractor(s) is retained to perform such service.

E-Verify* User identification Number

Date of Authorization for Contractor

Company Name

By: Authorized Officer or Agent

Date

Title of Authorized Officer or Agent of Contractor

Printed Name of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME THIS
____ DAY OF _____, 2025

Notary Public: _____

My Commission expires: _____

(NOTARY SEAL)

**As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is "E-Verify" operated by the U.S. Citizenship and Information Services Bureau of the U.S. department of Homeland Security, in conjunction with the Social Security Administration (SSA).*

SECTION 00 54 53
SUBCONTRACTOR AFFIDAVIT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. 13-10-91, stating affirmatively that the individual, firm or corporation which is engaged in the physical performance of services as a subcontractor for _____, the contractor which has a contract with City of Milledgeville, has registered with, is authorized to use and is participating in a federal work authorization program* [any of the electronic verification work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicability provisions and deadlines established in O.C.G.A. 13-10-91. The user identification number and the date of authorization for this subcontractor to use the federal work authorization program are set forth below. The undersigned subcontractor is using and will continue to use the federal work authorization program throughout the contract period.

E-Verify* User identification Number

Date of Authorization for Contractor

Company Name

By: Authorized Officer or Agent

Date

Title of Authorized Officer or Agent of Contractor

Printed Name of Authorized Officer or Agent

SUBSCRIBED AND SWORN BEFORE ME THIS
_____ DAY OF _____, 2025

Notary Public: _____

My Commission expires: _____

(NOTARY SEAL)

**As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is "E-Verify" operated by the U.S. Citizenship and Information Services Bureau of the U.S. department of Homeland Security, in conjunction with the Social Security Administration (SSA).*

SECTION 00 54 55
CITY OF MILLEDGEVILLE, GEORGIA
AFFIDAVIT VERIFYING STATUS FOR PUBLIC BENEFIT

By executing this affidavit under oath, as an applicant for a City of Milledgeville public benefit as referenced in O.C.G.A. § 50-36-1, I am stating the following with respect to my application for a City of Milledgeville public benefit for _____.

(Name of natural person applying on behalf of individual,
business, corporation, partnership, or other private entity)

1) _____ I am a United States citizen

OR

2) _____ I am a legal permanent resident eighteen (18) years of age or older or I am an otherwise qualified alien or non-immigrant under the Federal Immigration and Nationality Act eighteen (18) years of age or older and lawfully present in the United States.*

In making the above representation under oath, I understand that any person who knowingly and willfully makes a false, fictitious, or fraudulent statement or representation in an affidavit shall be guilty of a violation of O.C.G.A. § 16-10-20.

Signature of Applicant

Printed Name of Applicant

Date

*Alien registration number for non-citizens

Sworn to and subscribed

Before me this _____ Day of _____, 2025

Notary Public

My Commission Expires:

(NOTARY SEAL)

*Note: O.C.G.A. § 50-36-1(e)(2) requires that aliens under the federal Immigration and Nationality Act, Title 8 U.S.C., as amended, provide their alien registration number. Because legal permanent residents are included in the federal definition of "alien," legal permanent residents must also provide their alien registration number. Qualified aliens that do not have an alien registration number may supply another identifying number below:

SECTION 00 54 57
CERTIFICATE OF OWNER'S ATTORNEY

I, the undersigned _____, the duly authorized and acting legal representative of City of Milledgeville, Georgia, do hereby certify as follows:

I have examined the attached Contract(s) and Performance and Payment Bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions, and provisions thereof.

Attorney for Owner

Date: _____

**SECTION 00 61 13.13
PERFORMANCE BOND**

Contractor Name: _____ Address (<i>principal place of business</i>): [_____	Surety Name: _____ Address (<i>principal place of business</i>): _____
Owner Name: City of Milledgeville, Georgia Mailing address (<i>principal place of business</i>): 119 East Hancock Street Milledgeville, Georgia 31061	Contract Description (<i>name and location</i>): City of Milledgeville , Georgia, Lamar Ham Water Treatment Plant Improvements, August 2025 Contract Price: _____ Effective Date of Contract: _____
Bond Bond Amount: _____ Date of Bond: _____ (<i>Date of Bond cannot be earlier than Effective Date of Contract</i>) Modifications to this Bond form: ☐ None ☐ See Paragraph 16	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner 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: **[Describe modification or enter “None”]**

**SECTION 00 61 13.16
PAYMENT BOND**

Contractor Name: Address (<i>principal place of business</i>): [	Surety Name: Address (<i>principal place of business</i>):
Owner Name: City of Milledgeville, Georgia Mailing address (<i>principal place of business</i>): 119 East Hancock Street Milledgeville, Georgia 31061	Contract Description (<i>name and location</i>): City of Milledgeville, Georgia, Lamar Ham Water Treatment Plant Improvements, August, 2025 Contract Price: Effective Date of Contract:
Bond Bond Amount: Date of Bond: <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: ☐ None ☐ See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

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

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

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

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

APPLICATION FOR PAYMENT

Prepared By



Endorsed By



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GUIDELINES FOR THE INTENDED USE OF EJCDC C-620, APPLICATION FOR PAYMENT

1.0 PURPOSE AND INTENDED USE OF THE DOCUMENT

The Application for Payment is used to facilitate periodic progress payments to the Contractor for Work completed and for stored materials and equipment (referred to in this document as "Stored Materials").

For additional information regarding the Application for Payment, see EJCDC® C-700, Standard General Conditions of the Construction Contract (2018), Paragraph 15.01, and EJCDC® C-001, Commentary on the 2018 EJCDC Construction Documents (2018).

2.0 APPLICATION FOR PAYMENT OVERVIEW

This document was prepared in Microsoft Excel due to the number of calculations involved in the preparation of the Application for Payment. The application consists of a Summary worksheet, and 3 supporting worksheets: Lump Sum worksheet, Unit Price worksheet, and Stored Materials worksheet.

- 2.1 *Summary Worksheet* — calculates the amount to be paid to the Contractor at the end of each Application for Payment period. This calculation imports numbers from the supporting worksheets to determine the value of the Work completed and Stored Materials, calculate retainage, and deduct amounts previously paid to determine the amount the Contractor should be paid for the current application period. Application periods are typically one month; however these periods may be extended when Contractor's efforts do not result in the billable completion of Work or storage of materials and equipment during the payment period.
- 2.2 *Lump Sum Worksheet* — calculates the total value for completed Work for which compensation is paid on a Lump Sum basis. The schedule of values included in this worksheet reflects a breakdown of lump sum Work items to which Contractor and Engineer have agreed, pursuant to Article 2 of the General Conditions. Costs for Stored Materials associated with lump sum items are included on this worksheet to calculate the total value for completed lump sum Work and associated Stored Materials. This total is exported to the Summary worksheet. Separate totals for Work Completed and for materials currently stored are also exported to the Summary worksheet for use in calculating the amount of retainage to be held for each.
- 2.3 *Unit Price Worksheet* — calculates the total value for completed Work for which compensation is paid on a Unit Price basis. The schedule of values included in this spreadsheet is typically a tabulation of Unit Price items from the Agreement. Costs for Stored Materials associated with unit price items are included in this worksheet to calculate the total value for completed Unit Price Work and associated Stored Materials. This total is exported to the Summary worksheet. Separate totals for Work Completed and for Materials Currently Stored are also exported to the Summary worksheet for use in calculating the amount of retainage to be held for each.

- 2.4 *Stored Materials Worksheet* — calculates the total value for materials and equipment that have been purchased and are being stored until they are incorporated into the Work. This worksheet adds materials and equipment to the worksheet as they are brought to the site and stored; such Stored Materials are then deducted from the Stored Materials worksheet total as they are incorporated into the Work, providing a running net value for the materials and equipment remaining in storage. The values of Stored Materials must be manually added to the Lump Sum or Unit Price line items. These do not automatically update when changes are made. The amount of materials remaining in storage is eligible for payment but must be tracked separately from Work completed since different retainage rates may apply to Work completed and Stored Materials.

3.0 Instructions for filling out the Payment Application form

- 3.1 Project-specific information is to be entered in the top portion (header) of the Summary worksheet. This same information will automatically be copied to the other worksheets to complete the headers on all other worksheets.
- 3.2 Outside of the header, data can be entered in non-shaded cells when the sheet is protected. Cells shaded light blue contain equations that will automatically transfer data from other cells or make calculations to complete the worksheet. Altering any of these cells can result in errors in the Application for Payment. It is recommended that the worksheets be protected at all times unless alterations are deliberately being made to the Application for Payment form other than to enter data. See Paragraph 4.0 below for information on Protection of Worksheets.
- 3.3 Enter information regarding each item in the Lump Sum and/or Unit Price worksheets. For Lump Sum projects, each item should represent an item in the schedule of values prepared by the Contractor and approved by the Engineer/Owner, breaking down the Lump Sum amount into measurable components. For Unit Price contracts, use numbers from the Agreement as the schedule of values. Specific information on the data to be entered into each column may be seen by clicking on the header description for that column. Similar comments may be seen for cells in the "Totals" row that indicates how the number is calculated and where this number is exported to another part of the spreadsheet. See the Commentary for additional information.
- 3.4 The equations in the Summary worksheet use numbers imported from both the Lump Sum and Unit Price worksheets. Projects will typically either use the Lump Sum or the Unit Price worksheet, but some projects may use both. If one of the worksheets is not used, it should be hidden and not deleted. If it is deleted, Users will need to correct the equations in the Summary worksheet by unprotecting the worksheet and editing the equations. To hide a worksheet, right click on the worksheet tab at the bottom of the worksheet and select "Hide." To unhide a worksheet, right click on any worksheet tab and select "Unhide," and then select the worksheet to unhide and click "Okay." This same process may be used to hide these Guidelines for Use.
- 3.5 EJCDC C-620 contains calculation functions that are provided solely for the convenience of the user. EJCDC and its Sponsoring Organizations do not warrant or guarantee the accuracy or completeness of any information generated by the calculator.

4.0 Protection of Worksheets

- 4.1 The cells in this Workbook that create the forms or contain equations have been coded to "lock" the cells that should not be altered. It is recommended that the Workbook be Protected (cells locked) at all times unless it is necessary to add or delete rows. Directions for adding and deleting rows are provided in the next section. Passwords can be used to lock the Protect / Unprotect settings on spreadsheets, however the worksheets in this workbook do not require a password.
- 4.2 To unprotect a worksheet, click on the "Review" menu tab at the top of Excel, then click "Unprotect Sheet." To protect a worksheet, click on the "Review" menu tab at the top of Excel, then click "Protect Sheet." This will open a dialog box in which the User is allowed to select protection options. It is recommended that only the top two checkboxes for "Select Locked Cells" and "Select Unlocked Cells" be checked. This will reset the protection for the Worksheet.

5.0 Adding and Deleting Rows

- 5.1 A limited number of blank rows are provided in the Lump Sum, Unit Price, and Stored Material worksheets. Additional rows may be added to these worksheets by the User. The first step in this process is to unprotect the worksheet as previously discussed. After the sheet is unprotected, move with caution to prevent inadvertently deleting any cells that contain equations. To insert a row, right click in the row heading at the left of the spreadsheet and select "Insert." A new row will be inserted at the location where the cursor was placed in the row heading. If more than one new row is desired, left click and drag the cursor to include the desired number of rows, right click in the selected row headings and then select "Insert." It is important that the line immediately above the "Totals" row not be included in the rows selected. Doing so will require that equations in the "Totals" row be adjusted. When rows are inserted, Excel automatically adjusts the equations to include the new rows, unless the row directly above the "Totals" row is also selected.
- 5.2 After new rows are inserted, it is important to copy a line from one of the original rows so correct formatting and equations are copied into each new row. To do this, select the row to be copied by clicking the cell in Column A and dragging the cursor to the last column in the table. Then select "Copy" from the menu or type CTRL+C to copy the cells. Excel will show that this row has been copied by showing a moving dashed line around the cells that are to be copied. Then select the new rows into which the information is to be copied as before and select Paste from the menu or type CTRL+V.
- 5.3 To delete an unused row, right click in the row heading on the left of the spreadsheet for the row to be deleted and select "Delete." The selected row will be deleted. If more than one row is to be deleted, left click and drag the cursor to the desired number of rows to be deleted and then right click to open the menu and select "Delete." Unlike the admonition on adding new rows, it is okay to delete the row just above the "Totals" row.
- 5.4 After rows have been added or deleted, it is important reset the worksheet protection.

6.0 Saving Files

This file is provided as a Microsoft® Excel Open XML workbook template (.xltx) to prevent this file from being inadvertently changed. When an application for payment is created for a specific project it should be saved as an Excel workbook (.xlsx) file. To do this, select Save As (F12), type in a new file name and select Excel Workbook (.xlsx) from the drop down Save As Type menu.

7.0 License Agreement

This document is subject to the terms and conditions of the License Agreement, 2018 EJCDC® Construction Series Documents. A copy of the License Agreement was furnished at the time of purchase of this document, and is available for review at www.ejcdc.org and the websites of EJCDC's sponsoring organizations.

Contractor's Application for Payment

Owner: _____ Engineer: _____ Contractor: _____ Project: _____ Contract: _____	Owner's Project No.: _____ Engineer's Project No.: _____ Contractor's Project No.: _____																																				
Application No.: _____ Application Date: _____																																					
Application Period: From _____ to _____																																					
<table style="width: 100%; border-collapse: collapse;"><tr><td style="width: 70%;">1. Original Contract Price</td><td style="width: 10%; text-align: center;">\$</td><td style="width: 20%; text-align: right;">-</td></tr><tr><td>2. Net change by Change Orders</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td>3. Current Contract Price (Line 1 + Line 2)</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td>4. Total Work completed and materials stored to date (Sum of Column G Lump Sum Total and Column J Unit Price Total)</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td>5. Retainage</td><td></td><td></td></tr><tr><td> a. _____ X \$ - Work Completed =</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td> b. _____ X \$ - Stored Materials =</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td> c. Total Retainage (Line 5.a + Line 5.b)</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td>6. Amount eligible to date (Line 4 - Line 5.c)</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td>7. Less previous payments (Line 6 from prior application)</td><td></td><td></td></tr><tr><td>8. Amount due this application</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr><tr><td>9. Balance to finish, including retainage (Line 3 - Line 4 + Line 5.c)</td><td style="text-align: center;">\$</td><td style="text-align: right;">-</td></tr></table>		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 + Line 5.c)	\$	-
1. Original Contract Price	\$	-																																			
2. Net change by Change Orders	\$	-																																			
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b. _____ X \$ - Stored Materials =	\$	-																																			
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8. Amount due this application	\$	-																																			
9. Balance to finish, including retainage (Line 3 - Line 4 + Line 5.c)	\$	-																																			
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 By: _____ Title: _____ Date: _____	Approved by Owner By: _____ Title: _____ Date: _____																																				
Approved by Funding Agency By: _____ Title: _____ Date: _____	 By: _____ Title: _____ Date: _____																																				

Contractor's Application for Payment

Owner:						Owner's Project No.:		
Engineer:						Engineer's Project No.:		
Contractor:						Contractor's Project No.:		
Project:								
Contract:								
Application No.:		Application Period:		From	to	Application Date:		
A	B	C	D	E	F	G	H	I
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		\$ -	\$ -	\$ -	\$ -	\$ -		\$ -

Contractor's Application for Payment

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Contractor's Application for Payment

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

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Progress Estimate - Unit Price Work

Contractor's Application for Payment

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

Application No.:		Application Period:		From		to		Application Date:				
A	B		C	D	E	F	G	H	I	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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Contractor's Application for Payment

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

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

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**STANDARD GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT**
Modified Version of EJCDC-C700

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**STANDARD GENERAL CONDITIONS
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ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The 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~~ 90th 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. **The delay shall be communicated to the on-site Resident Project Representative with the next pay application. Frivolous delays shall be denied.**
- 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.
 5. **Rain outside of monthly averages as determined by NOAA**
 6. **Site flooding or mud days to said rain may be approved by the Resident Project Representative when submitted with the monthly pay application.**
 7. **Lead times on critical project materials.**
- 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.
 6. **Include Public Liability and Property Damage Liability Insurance:** Contractor shall carry, with respect to the operations they perform, regular General Liability Insurance providing for a limit of not less than one million dollars (\$1,000,000) for all damage arising out of bodily injuries to or death of one person, and subject to that limit for each person, a total of one million dollars (\$1,000,000) for all damage arising out of bodily injuries to or death of two or more persons in any one accident, and regular Employer's Property Damage Liability Insurance providing for a limit of not less than five hundred thousand dollars (\$500,000) for all damages arising out of injury to or destruction of property in any one accident and subject to that limit per accident, a total (or aggregate) limit of two million dollars (\$2,000,000) for all damages arising out of injury to or destruction of property during the Policy period. If any part of the work is sublet, similar insurance, in the same amounts as required of the Contractor shall be provided by or in behalf of the subcontractor to cover their operation.
 7. **Include Automobile Liability Insurance:** (a) Bodily injury in an amount not less than five hundred thousand dollars (\$500,000) including accidental death to any one person, and, subject to the same limit for each person, in an amount not less than one million dollars (\$1,000,000) on account of one accident, (b) Property damage in an amount not less than one hundred thousand dollars (\$100,000) for any one damage claim, and in an aggregate amount up to two hundred fifty thousand dollars (\$250,000) during the Policy Period.
- 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.

- D. At least 50% of the labor for each job shall be performed by the General Contractor. All bids without this intent shall be noted in the bidding package with a letter explaining why 50% General Contractor self-performance of work is unattainable.**

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~~ **shall** 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. **Final payment does not waive the Owner's right to Claims or litigation.**

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~~ 15 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~~ **Fifteen (15)** days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. Reductions in Payment by Owner

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

injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

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

15.02 *Contractor's Warranty of Title*

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

15.03 *Substantial Completion*

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

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

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

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

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

15.05 *Final Inspection*

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

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release

or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim, appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas;

2. correct such defective Work;
 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

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

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

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

16.04 *Contractor May Stop Work or Terminate*

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

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
 - 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

- B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:
1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

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

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract,

will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

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

18.08 *Assignment of Contract*

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

18.09 *Successors and Assigns*

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

18.10 *Headings*

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

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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

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

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, “Paragraph SC-4.05.”

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

No Supplementary Conditions in this Article.

ARTICLE 2—PRELIMINARY MATTERS

No Supplementary Conditions in this Article

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

No Supplementary Conditions in this Article

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

No Supplementary Conditions in this Article

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

5.03 Subsurface and Physical Conditions

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

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

Report Title	Date of Report	Technical Data
Geotech. Engineering Report, Milledgeville, Georgia (Terracon)	Sept 27, 2024	Geotechnical Report
Geotechnical Engineering Report – MSE Wall External Stability Analyses	September 15, 2025	Geotechnical Report

- F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to

the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely

Drawings Title	Date of Drawings	Technical Data
No Applicable Drawings		

- G. Contractor may examine copies of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents at offices of Owner and Engineer during regular business hours, or may request copies from Engineer for a nominal cost.

5.06 Hazardous Environmental Conditions

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
No known reports exist		[Identify Technical Data]

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
No known drawings exist		[Identify Technical Data]

ARTICLE 6—BONDS AND INSURANCE

No Supplementary Conditions in this Article

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.07 Concerning Subcontractors and Suppliers

SC-7.07 Add the following sentence at the end of Paragraph 7.07.A:

The Contractor shall not award work to Subcontractor (s) in excess of 50% of the contract price, without prior written approval of the Owner.

ARTICLE 8—OTHER WORK AT THE SITE

No Supplementary Conditions in this Article

ARTICLE 9—OWNER’S RESPONSIBILITIES

No Supplementary Conditions in this Article

ARTICLE 10—ENGINEER’S STATUS DURING CONSTRUCTION

No Supplementary Conditions in this Article

ARTICLE 11—CHANGES TO THE CONTRACT

No Supplementary Conditions in this Article.

ARTICLE 12—CLAIMS

No Supplementary Conditions in this Article.

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

13.01 Cost of the Work

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

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

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

No Supplementary Conditions in this Article.

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

No Supplementary Conditions in this Article.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No Supplementary Conditions in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

No Supplementary Conditions in this Article.

ARTICLE 18—MISCELLANEOUS

SECTION 00 91 13

ADDENDA

The contract documents have been modified by the attached Addenda:

Addendum No.:	Date

END OF SECTION

DIVISION 01
GENERAL REQUIREMENTS

SECTION 01 10 00

SUMMARY OF WORK

PART 1 - GENERAL

1.01 SUMMARY

- A. The work covered under these Contract Documents includes the work as described in the plan set entitled – “Lamar Ham Water Treatment Plant Improvements – Contract I” and the work as described in the plan set entitled “Lamar Ham Water Treatment Plant – Ceramic Membrane Pilot – Contract II.”
 - 1. Both sets of plans will utilize this specification book.
 - 2. Both sets of plans and this specification book will govern the construction of all improvements under two contracts as described in Section 1.02.A .1 and 102.A.2 below.
- B. Access to site - Contractor will be provided with access to the site. It is the responsibility of the contractor to provide site security during working and non-working hours and to provide access to the Owners employees, including maintenance, operations, contractors and others who are involved in plant operations at the site.
- C. Contractor shall coordinate with the City of Milledgeville, Lamar Ham operations staff and others who are involved in plant operations at the site for any and all shut-downs, bypasses, or other inconveniences and interruptions to plant operations.
- D. Work restrictions – Work is restricted to 7 am to 7 pm Monday through Friday. Weekend work will be approved on a case by case basis.

1.02 PROJECT INFORMATION

- A. Project Identification:
 - 1. Project Name: Lamar Ham Water Treatment Plant Improvements – Contract I
 - 2. Project Name: Lamar Ham Water Treatment Plant – Ceramic Membrane Pilot – Contract II
 - 3. Project Location: 510 E. Montgomery Street, Milledgeville, Georgia 31061
 - 4. Project Number: 232645
- B. Owner:
 - 1. Owner's Name: City of Milledgeville
 - 2. Owner's Representative: Robert Hadden
 - 3. Owner's Address: 119 East Hancock Street, Milledgeville, Georgia 31061
- C. Engineer:

1. Engineer's Name: Turnipseed Engineers
2. Engineer's Address: 4210 Columbia Rd, Augusta, GA 30907
3. Engineer's Representative: W. David Tyre, P.E.

1.03 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Type of Contract:

- a. Project will be constructed under two Contracts as described in Section 1.02.A .1 and 102.A.2

B. Scope of Work:

1. Contract I – Water Treatment Plant Improvements

- a. General construction of cast-in-place 2 million gallon clearwell, two story control building with walkways to existing filter gallery and operating floor. Reworked entrance and parking area with tiered, landscaped retaining wall. Pump house atop new clearwell with high service and backwash pump station. New chemical building and bulk chemical tankage. These improvements will be constructed with associated yard piping, chemical piping, sample piping, grading, roadways, excavation, painting, mechanical improvements, equipment and appurtenances.
- b. Site improvements including Grading, retaining wall, structural fill as directed by the Geotechnical Engineer, paving, yard piping and fencing.
- c. Building construction including new buildings as shown on the plans including concrete, masonry, brick masonry, metal studs, equipment installation, heavy interior piping, electrical, plumbing and other trades as necessary for construction.
- d. Mechanical systems including pumps and other equipment.
- e. Electrical systems including Low and high voltage equipment and panels, including SCADA (by allowance).
- f. Plumbing systems including floor drains, scuppers, employee water closets, lab sinks, locker rooms, and maintenance sinks and drains, etc.
- g. Heating, Ventilation and Air Conditioning improvements include climate control for buildings, intake and exhaust, piping insulation and heat tracing, unit heaters, louvers, thermostats and other appurtenances.

2. Contract II – Membrane Treatment Pilot:

- a. Demolition of two existing filters and associated piping.
- b. Mechanical, structural and electrical installation of a full scale, 2 million gallon per day ceramic membrane pilot. Pilot installation will become a permanent filter installation, if successful.

- c. Electrical systems including Low and high voltage equipment and panels, including SCADA (by allowance).
- d. The connection of proposed piping to existing piping within the existing water treatment plant pipe gallery.
- e. Building modifications, stairs and platforms to provide operator access to pilot plant.

1.04 WORK UNDER SEPARATE CONTRACTS

- A. Contracts I and II

1.05 ACCESS TO SITE

- A. General: Contractor shall have full use Project site for construction operations as indicated by Contract documents with the burden of notification, coordination and security as indicated by requirements of this Section.
- B. Use of Site:
 - 1. Maintain drives, walkways, and entrances serving premises clear and available for operations staff
 - 2. Schedule deliveries to minimize space and time requirements
 - 3. Coordinate with Owner's security requirements

1.06 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy:
 - 1. Owner will occupy site and existing building(s) during entire construction period
 - 2. Cooperate with Owner during construction operations
 - 3. Minimize conflicts and facilitate Owner usage
 - 4. Maintain access to existing walkways, corridors, and other adjacent occupied facilities

1.07 WORK RESTRICTIONS

- A. Work Hours:
 - 1. Weekday Hours: 7 am to 7 pm unless otherwise approved by the Owner.
 - 2. Weekend Hours: Subject to review and approval for limited durations
 - 3. Early Morning/Late Night Hours: Subject to review and approval

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONTRACTOR'S RESPONSIBILITIES

A. Project Management:

1. Supervise and direct all work
2. Maintain competent superintendent
3. Coordinate all construction activities
4. Maintain required documentation

B. Project Coordination:

1. Coordinate work of subcontractors
2. Coordinate with separate contractors
3. Coordinate with Owner's operations
4. Maintain project schedule

C. Site Operations:

1. Maintain clean site and building
2. Provide security measures
3. Control noise and dust
4. Protect existing facilities
5. Ensure no interruptions in water treatment for the City of Milledgeville

3.02 PROJECT MEETINGS

A. Preconstruction Conference:

1. Schedule before starting construction
2. Review administrative procedures
3. Establish communication protocols
4. Review critical work sequencing

B. Progress Meetings:

1. Scheduled as necessary
2. Attended by key project personnel
3. Review progress and scheduling and address current issues

END OF SECTION

SECTION 01 21 00

ARCHITECTURAL ALLOWANCES

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division -1 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. This section specifies administrative and procedural requirements governing handling and processing allowances.
- B. Types of allowances required include the following:
 - 1. Refer to Schedule of Allowances.

1.03 SUBMITTALS:

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.04 CONTINGENCY ALLOWANCES:

- A. Use the contingency allowance only as directed by such persons or entities as the Owner may direct, and only by Change Orders which designate amounts to be charged to the allowance.
 - 1. The Contractor's related costs for products or equipment ordered by the Owner under the contingency allowance, including delivery, installation, taxes, insurance, equipment rental, and similar costs are not part of the Contract Sum.
 - 2. Change Orders authorizing use of funds from the contingency allowance will NOT include the Contractor's related costs and reasonable overhead and profit margins, which are part of the Contract Sum/ GMP. These costs, overhead, & profit amounts should be imbedded in GMP as if the entire allowance will be used.
 - 3. At Project closeout, credit unused amounts remaining in all allowances to Owner by Change Order.

PART 2 - PRODUCTS: NOT USED

PART 3 - EXECUTION:

3.01 INSPECTION:

- A. Inspect products covered by an allowance promptly upon delivery for damage or defect.

3.02 PREPARATION:

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

3.03 SCHEDULE OF ALLOWANCES:

- A. Allowance No. 1: Ceramic Tile - Include in Base Bid an allowance of eleven dollars and fifty cents (\$11.50) per square foot for ceramic tile, material only; reference Section 09 3013 - Ceramic Tile. Taxes and shipping shall be added to the material cost. Preparation, grout, mortar, and installation shall be included in base bid.
- B. Allowance No. 2 Luxury Vinyl Tile - Include in Base Bid an allowance of four dollars and seventy-five cents (\$4.75) per square foot for luxury vinyl tile or plank, material only; reference Section 09 6500 - Resilient Flooring. Taxes and shipping shall be added to the material cost. Preparation, adhesives, and installation shall be included in base bid.
- C. Allowance No. 3 Carpet Tile - Include in Base Bid an allowance of thirty dollars (\$30) per square yard for carpet tile, material only; reference Section 09 6813 - Carpet Tile. Taxes and shipping shall be added to the material cost. Preparation, adhesives, and installation shall be included in base bid.

END OF SECTION

SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Procedural requirements for requesting material or equipment substitutions or preapproval including the Contractor's responsibilities.

B. Substitutions for specified products are allowed only under the conditions stated in this section.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 33 00 – Submittal Procedures

1.03 SUBSTITUTIONS/PRIOR APPROVALS

A. To use products different from those indicated in the Contract documents, the requesting party must submit a written application as described herein. The burden of proving the equivalence of proposed substitutions rests with the requesting party.

B. The Owner is not obliged to consider substitution requests received less than ten (10) working days before the bid opening, nor requests submitted by the awarded contractor after the bid opening or during construction.

1.04 SUBMITTAL REQUIREMENTS

A. Submit a separate request for each substitution.

B. Support each request with the following information:

1. Date of request
2. Name of the party proposing the substitution
3. Project name
4. Specification reference
5. Complete data substantiating the compliance of the proposed substitution with the Contract Documents:
 - a. Product identification, including manufacturer's name and address.

- b. Manufacturer's literature, including:
 - 1) Product description
 - 2) Reference standards
 - 3) Performance and test data
 - 4) Manufacturer's recommendations for use and installation
- c. Samples, as applicable
- d. Names and addresses of similar projects using the product, with installation dates
- 6. Itemized comparison of the proposed substitution with the specified product, listing all variations
- 7. Data related to changes in the construction schedule
- 8. List of changes required in other work or products
- 9. Designation of required license fees or royalties
- 10. Availability of maintenance services and sources for replacement materials
- 11. Identification of elements in the design that must be modified to accommodate the proposed item and ensure proper functioning within the overall system.

1.05 CONTRACTOR'S RESPONSIBILITIES

- A. When using any substitute item approved by the Engineer, it is the Contractor's responsibility to ensure that such items meet all space requirements. If a manufacturer or product other than the first named requires modification to the Work, the Contractor must:
 - 1. Review and revise the design as necessary.
 - 2. Coordinate with other technical sections to ensure proper fit and function of all components. All modifications must meet the Engineer's satisfaction.
- B. The Contractor shall bear all costs and liabilities associated with redesigning any Work elements to accommodate the proposed item.
- C. The Contractor must provide complete engineered drawings addressing all required design modifications. Drawings must be sealed by a professional engineer registered in the State of Georgia.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 02

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Measurement and payment criteria
 - 2. Schedule of values requirements
 - 3. Unit price procedures
 - 4. Lump sum payment procedures
 - 5. Progress payment procedures
 - 6. Change order procedures
 - 7. Payment for stored materials

1.02 RELATED REQUIREMENTS:

- A. Related Specification
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 77 00 - Closeout Procedures

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate preparation of Schedule of Values and Schedule of Payments with construction schedule
 - 2. Submit payment requests in accordance with established schedule
 - 3. Coordinate quantities for measurement with record documents
- B. Preconstruction Conference:
 - 1. During the Preconstruction Conference, prior to first Application for Payment, the following procedures shall be reviewed:
 - a. Schedule of Values
 - b. Application and Payment procedures
 - c. Documentation requirements and required forms

- d. Change order procedures as described in these specifications.

1.04 SCHEDULE OF VALUES

A. Format:

1. Schedule of Values shall be submitted in the Engineer's Pay Estimate format
2. The Project Bid Form and Specification Table of Contents shall be used as the basis of format.
3. Work shall be listed in sufficient detail to accurately determine the quantity of work completed.

B. Content:

1. The Schedule of Values must accurately identify the Project and any Divisions thereof.
2. Provide division of Work by Specification section.
3. Major materials and equipment
4. Labor costs
5. Overhead and profit
6. General requirements costs

C. Preparation:

1. Break down principal contract into specific items
2. Break down major subcontracts
3. Round figures to nearest dollar
4. Make sum of values equal to Contract Sum

1.05 MEASUREMENT PROCEDURES

A. General:

1. The Contractor and Engineer's representative shall take measurements jointly.
2. Measurements must be recorded in units indicated in Contract Documents
3. The Contractors shall maintain detailed measurement records

B. Unit Quantities:

1. Measured by established dimensions
2. Computed by standard engineering methods
3. Actual quantities installed

4. No allowance for waste or overlap

C. Area Measurements:

1. Measured horizontally in place
2. No deductions for individual fixtures less than 30 square feet
3. No deductions for piping or conduit less than 6 inches diameter

D. Linear Measurements:

1. Measured parallel to item being measured
2. No allowance for vertical surfaces
3. Minimum lengths as specified

E. Volume Measurements:

1. Measured in place
2. No deductions for reinforcing steel
3. No deductions for embedded items less than 1 cubic foot

1.06 PAYMENT PROCEDURES

A. Unit Price Work:

1. Based on measured quantities
2. Include all necessary labor, materials, and equipment
3. Include overhead and profit
4. No additional payment for waste or overlap

B. Lump Sum Work:

1. Based on percentage complete
2. Supported by detailed breakdown
3. Include all costs for complete installation
4. Include overhead and profit

C. Progress Payments:

1. Submit monthly
2. Use Engineer's Pay Estimate Format
3. Include updated Schedule of Values

4. Include supporting documentation

D. Stored Materials:

1. Materials stored on site: paid at 100% of value
2. Materials stored off site:
 - a. Paid at 75% of value
 - b. Require proof of insurance
 - c. Require bill of sale
 - d. Require right of access

1.07 CHANGE PROCEDURES

A. Change Order Pricing:

1. Detailed breakdown of costs
2. Labor rates including burden
3. Material costs with supporting quotes
4. Equipment rates
5. Overhead and profit per Contract

B. Time and Material Work:

1. Daily work reports required
2. Signed by both parties
3. Include:
 - a. Labor hours and rates
 - b. Equipment hours and rates
 - c. Materials used

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 APPLICATIONS FOR PAYMENT

A. Preparation:

1. Complete every entry

2. Notarize and execute
3. Include supporting documentation

B. Initial Application:

1. Administrative actions and submittals that must precede include:
 - a. List of subcontractors
 - b. Schedule of Values
 - c. Construction schedule
 - d. Submittal schedule

C. Progress Applications:

1. Include Work completed
2. Include stored materials
3. Include change orders after execution
4. Retain standard percentage for incomplete work

D. Final Application:

1. Submit after completion of Project closeout requirements
2. Include final Change Orders
3. Include release of liens
4. Include consent of surety
5. Include final documentation

3.02 MEASUREMENT OF QUANTITIES

A. Weight Measurements:

1. Concrete measured by cubic yard
2. Reinforcing steel by pound
3. Structural steel by pound

B. Volume Measurements:

1. Excavation by cubic yard
2. Fill by cubic yard
3. Grout by cubic foot

C. Area Measurements:

1. Paving by square yard
2. Painting by square foot
3. Waterproofing by square foot
4. Grassing by square foot
5. Clearing by acre.

D. Linear Measurements:

1. Pipe by linear foot
2. Fencing by linear foot
3. Curbing by linear foot

3.03 UNIT PRICES

A. Authority:

1. Measurement methods delineated in individual specification sections take precedence.
2. Measurement are to be made jointly with the Contractor and Engineer's Representative.

B. Unit Price Schedule:

1. Item: [Description]
2. Unit of Measurement: [Unit]
3. Method of Measurement: [Method]
4. Includes: [List included items]
5. [Add additional items as required]

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Procedural requirements for submittals including construction progress schedules, working drawings, shop drawings, product data, samples, schedule of values and other miscellaneous work-related submittals.

- B. For administrative submittal requirements, refer to other Division 1 Sections and Contract Documents.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 25 00 - Substitution Procedures
2. Section 01 40 00 - Quality Requirements
3. Section 01 77 00 - Closeout Procedures
4. Section 01 78 23 - Operation and Maintenance Data
5. Section 01 78 39 - Project Record Documents

1.03 SUBMITTAL PROCEDURES

A. General

1. Prepare and submit submittals required by individual Specification Sections.
2. Submit closeout submittals as indicated in Section 01 77 00.

- B. Coordinate the preparation and processing of submittals with construction activities. Transmit each submittal well in advance to avoid delays.

- C. Allow sufficient review time to prevent installation delays due to submittal processing, including time for resubmittals.

D. Submittal Identification:

1. Each submittal shall be accompanied with a cover sheet that bears the following information:
 - a. Project Name and Engineer's project number

- b. Contractor's name and Project Number:
- c. Submittal Date
- d. Submittal Number: Submittal numbers shall be sequentially numbered without division by trades. Resubmittals shall be given the number of the original submittal followed by the letter A for the first resubmittal, the letter B for the second resubmittal, etc. (Example: 10A, 10B, etc.)
 - 1) Sample Identification: Samples, color charts or similar data shall be identified as a decimal of the related submittal number. (Example: If the flooring submittal is Number 10, all samples related to the flooring submittal shall be numbered 10.1, 10.2, 10.3, etc.)
- e. Item Name
- f. Location: Identify the location(s) where the material or equipment is to be placed. (Example: RAS pump station, yard piping, construction joints greater than 12" thick.) The noted location shall be as specific as possible.
- g. Subcontractor or Supplier: Identify the equipment or material provider.
- h. Manufacturer: Identify the manufacturer of the material or equipment being submitted.
- i. Drawing or Identification Number: When available, list the shop drawing or identification number given by the contractor, supplier or manufacturer. Such numbers are typically found shop drawings for piping details, reinforcing steel, miscellaneous metals, etc.
- j. Specification Section: Identify the Specification Section(s) applicable to the equipment or material being submitted.
- k. Deviations: Contractor shall note on the submittal cover sheet if the submittal contains any deviations to the contract documents.
- l. Contractor's Review Stamp: Contractor shall include on the cover sheet his/her review stamp, including signature and date, indicating the submittal has been checked for compliance with the contract documents and the status of that review.

E. Contractor's Review

- 1. The Contractor shall check all submittals for accuracy of dimensions and details and for conformation with the Drawings and Specifications before submitting working drawings to the Engineer for review. The Contractor shall indicate that working drawings have been checked by him by affixing an appropriate stamp on the face of each of the working drawings and the submittal cover sheet. All notes by the contractor shall be in **GREEN**.
- 2. Pertinent Information: Where catalogs or data sheets include multiple listings, the Contractor shall highlight all entries that are pertinent to the submittal. Information that is not pertinent to the review shall be crossed out.

3. Deviations: The Contractor must clearly identify any deviations from the contract Specifications or Drawings and provide additional data that may be required for the Engineer's review. When applicable, the Contractor must identify any required modifications to other components resulting from the deviation and may include but not limited to structural components, piping systems, electrical systems, etc,

F. Engineer's Review:

1. The Engineer shall review all shop drawings for general compliance with the contract documents. All corrections required by the Engineer will be noted in RED.
2. The Engineer's review stamp shall be placed on the submittal cover sheet and/or the working drawing indicating the status of the returned submittal and date of review. The status of each review shall be indicated as follows:
 - a. No Exceptions Taken (NET): Work related to the submittal may proceed provided it complies with the contract documents.
 - b. Make Corrections Noted (MCN): Work related to the submittal may proceed provided the noted corrections are made and work complies with the contract documents. Resubmittal is not required.
 - c. Revise and Resubmit (R&R): Do not proceed with work related to the submittal. Submittal must be revised and resubmitted in accordance with the Engineer's review notes.
 - d. Rejected (REJ): Submittal was not accepted. Do not proceed with work related to the submittal. Submitted product data and shop drawings do not comply with the contract documents. Prepare a new submittal for material or equipment that comply with the contract documents.

G. Responsibility for Accuracy:

1. Verification of all dimensions, quantities, material, identification numbers and other similar details shall be the sole responsibility of the Contractor. The Contractor shall be responsible for agreement and conformity of working drawings with the Contract Drawings and Specifications. The Engineer's review stamp shall not relieve the Contractor or these responsibilities, including errors and omissions.

H. Resubmittals:

1. The Contractor shall verify that all corrections and additional information requested by the Engineer have been provided on the resubmittal. The Contractor shall clearly identify any additional revisions to the submittal that were not specifically called out or requested in the initial review. Resubmittals shall be numbered as noted in these Specifications

I. Electronic Submittals:

1. The Contractor shall submit one digital PDF copy of each of the submittals for the Engineer's review.
2. After reviewing the submittals, the Engineer will return the digital copy to the Contractor.

J. Submittal Hard Copies:

1. Unless otherwise directed in the Preconstruction Conference, the Contractor will forward three hard copies, exactly as marked in the returned digital copy, to the Engineer.

1.04 SCHEDULE OF SUBMITTALS

- A. Before major construction activities begin, the Contractor shall provide a list of required submittals, including shop drawings, product data, samples, and any other information needing review and approval by the Engineer. Each submittal must have an anticipated delivery date and identify critical path items.

1.05 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Prepare a fully developed horizontal bar-chart construction schedule and submit it within 30 days before the "Commencement of the Work.
- B. Prepare the schedule summary on a sheet that displays data for the entire construction period.
- C. Indicate significant stages of construction for each major portion of the work, including testing and installation.
- D. An updated schedule shall be submitted with each Periodic Pay Application..

1.06 WORKING DRAWINGS

- A. The Contractor must submit Working Drawings and details for Reinforcing Steel, Structural Steel, Miscellaneous Metals, Piping, and any other necessary items for the successful completion of the Project to the Engineer for review.

1. Review By Contractor

- a. The Contractor must verify all Working Drawings for accuracy of dimensions and details, ensuring conformity with the Construction Documents before submitting them to the Engineer for approval. The Contractor shall indicate this verification by affixing an appropriate stamp or notation on each Working Drawing.

2. Responsibility for Accuracy

- a. Approval of the Contractor's Working Drawings by the Engineer does not relieve the Contractor of the responsibility for the accuracy of dimensions and details. The Contractor remains responsible for ensuring that the Working Drawings conform to field conditions and the Contract Documents.

1.07 SHOP DRAWINGS

- A. Submit newly prepared information on reproducible sheets, drawn to scale, with the preparer's name indicated. Highlight deviations from the Contract Documents. Do not reproduce Contract Documents or standard information.
- B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, sectional views, dimensions, materials, thicknesses, finishes, and similar drawings.

1. Except for templates and full-size drawings, submit Shop Drawings on sheets at least 18" x 24" and no larger than 30" x 42".
 2. The Contractor shall submit drawings and details to adequately describe the function, performance characteristics, dimensions, arrangement, support, anchorage and other similar information to allow for installation, operation and maintenance.
- C. Shop Drawings shall include legend for any abbreviations, line types, or other details as required for clarity. Items noted by mark numbers on the drawings shall be clearly identified in a material or equipment schedule provided on the drawings.
- 1.08 PRODUCT DATA
- A. Collect Product Data into a single submittal for each construction element or system. Product Data includes manufacturer's specifications, installation instructions, catalog cuts, color charts, templates, and other similar information. Mark each copy to indicate applicable choices and options.
- 1.09 COLORS AND SAMPLES
- A. Provide colors and samples as required by individual specification sections or when required for a complete and accurate review of the equipment or material. The samples should be submitted in the quantity required to be returned, plus one to be retained by the Engineer / Owner
- B. Submit full-size, fully fabricated samples that are cured and finished as specified and physically identical to the proposed material or product. Samples may include sections of components, cuts of materials, color range sets, and swatches. Prepare samples to match materials specified in the Construction Documents.
- C. Submit samples for review of kind, color, pattern, and texture for final checks and comparisons against delivered components.
- D. For selecting characteristics from a range of standard choices, submit a full set of options for the material or product.
- E. Field Samples or Mock-ups are special types of Samples specified in individual sections, representing "full-size" examples erected on site.
- F. All products requiring color or sample selection by the Owner shall be submitted as early as possible. The Engineer will coordinate selection with the Owner after all samples, colors and finishes for the accepted products have been received. The Engineer will provide the Contractor with a schedule of the Owner selected colors and finishes.
- 1.10 LETTERS OF MATERIAL OR EQUIPMENT CERTIFICATION
- A. Equipment and Material Certifications:
1. Submit a Letter of Certification for specified materials or equipment only when required in individual sections. The letter must certify compliance with the Contract Documents and include supporting data, test results, and compliance with standards.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes quality control and quality assurance requirements for the project

1.02 RELATED REQUIREMENTS

- A. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Individual Product Specification Sections

1.03 REFERENCE STANDARDS

- A. Abbreviations used in the Contract Documents are defined as follows:
 - 1. AASHTO: American Association State Highway and Transportation Officials
 - 2. ACI: American Concrete Institute
 - 3. AISC: American Iron and Steel Institute
 - 4. ANSI: American National Standard Institute
 - 5. ASTM: American Society for Testing and Materials
 - 6. AWWA: American Waterworks Association
 - 7. CRSI: Concrete Reinforcing Steel Institute
 - 8. EPD: Environmental Protection Division (Georgia Department of Natural Resources)
 - 9. MIL: Military Specification
 - 10. NSF: National Science Foundation
 - 11. UL: Underwriter's Laboratories

1.04 DEFINITIONS

- 1. Quality Assurance (QA): Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- 2. Quality Control (QC): Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements.

3. Mock-ups: Full-size physical assemblies that are constructed on-site to verify selections made under sample submittals, to demonstrate aesthetic effects, quality of materials and execution, and to set quality standards for materials and execution.
4. Product Testing: Tests and inspections that are performed by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
5. Source Quality-Control Testing: Tests and inspections that are performed at the source such as a plant, mill, factory, or shop.
6. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
7. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
8. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1.05 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.06 COMPETENT LABOR

- A. The Contractor shall employ only competent and skilled personnel on the work. Either the on-site project manager or the field superintendent, as listed in the Contractor's statement of qualifications, must be on site full-time for the duration of the project. The onsite project manager or the field superintendent shall have the authority to receive orders and execute the Work. Should there be a change from the listed on-site project manager and / or field superintendent, the Contractor is to submit resume of proposed personnel to Engineer for approval.

1.07 OWNER PROVIDED TESTING SERVICES

- A. The Owner will provide third-party testing services for the following:
 1. Geotechnical compaction testing
 2. Asphalt density testing
 3. Structural Concrete and Grout (Compressive strength, slump, air, etc.)

B. Contractor responsibilities for Owner Provided testing, in addition to the items listed in the “Contractor’s Testing Responsibilities” section below, include:

1. Assist with coordination and scheduling of the Owner’s testing agency Notify testing agencies minimum 24 hours prior to need.
2. Provide access to Work
3. Furnish incidental labor and facilities as required
4. Provide storage for test samples
5. Pay costs for additional testing due to non-compliance

1.08 CONTRACTOR’S TESTING RESPONSIBILITIES

A. All testing services not noted to be provided by the Owner shall be provided by the Contractor.

B. Retesting of Owner Provided Services, due to failure to meet the specified requirements, shall be paid for by the Contractor

C. Test and Inspection Log

1. The Contractor shall maintain a log at Project site containing:
 - a. Date test/inspection performed
 - b. Description of Work tested/inspected
 - c. Date test/inspection results issued
 - d. Results of tests/inspections
 - e. Requirements vs actual performance
 - f. Deficiencies observed
 - g. Corrective actions taken

D. Protect construction exposed during quality control activities

E. Repair and Protection

1. Upon completion of testing and inspection:
2. Repair damaged construction
3. Restore substrates and finishes

1.09 DEFECTIVE WORK

A. All materials furnished and work done by the Contractor at any time during the progress of the work shall be subject to the inspection of the Engineer, who shall have full power to accept or reject any part thereof. The Contractor shall remedy any defective or unsatisfactory work or material at no additional cost to the Owner. In the event the Contractor fails to initiate corrections within 48

hours after written notice, the Engineer shall have full right to have same done and to bill the Contractor for cost thereof. Any condemned material must be removed from the work within 24 hours at no additional cost to the Owner.

PART 2 - PRODUCTS: NOT USED

PART 3 - EXECUTION

END OF SECTION

SECTION 01 42 00

REFERENCES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Definitions and terminology used in the Contract Documents
2. Abbreviations and acronyms used in the Contract Documents
3. Owner referenced specifications where applicable

1.02 DEFINITIONS

A. Where the following words, or the pronouns used instead, occur herein, they shall have the following meaning :

1. Owner: The City of Milledgeville, Georgia, party of the first part to the "Contract Agreement" or its authorized and legal representative.
2. Engineer: Turnipseed Engineers of Atlanta, Georgia acting for the Owner or other representative of such party.
3. Contractor: The party of the second part to the "Contract Agreement", or the legal authorized representatives of such party.

1.03 ACRONYMS AND ABBREVIATIONS

1. Whenever the following terms or pronouns are used, whether in these Specifications or on the Plans, they are to be construed the same as the respective expressions represented

AASHO	American Association State Highway Officials
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
ALT	Alternate
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
AWWA	American Water Works Association
BTU	British Thermal Unit
CIP	Cast Iron Pipe

cft	Cubic Foot
cfs	Cubic Feet Per Second
clr	Clearance
cm	Centimeters
cy	Cubic Yard
db	Decibel
DI/CI	Ductile Iron / Cast Iron
DIP	Ductile Iron Pipe
DOC	United States Department of Commerce
DOT	Georgia Department of Transportation
DR	Dimension Ratio
EEO	Equal Employment Opportunity
EPD	Environmental Protection Division
EX.	Existing
F	Fahrenheit
FH	Fire Hydrant
FL or FLG	Flange
ft	Feet
G.A.B.	Graded Aggregate Base
GAL.	Gallon
GEFA	Georgia Environmental Finance Authority
GPM	Gallons Per Minute
H.S.	High Service
in	Inch
kg	Kilograms
lb	Pounds
LF	Linear Feet
MH	Manhole

MGD	Million Gallons Per Day
MJ	Mechanical Joint
OSHA	Occupational Safety and Health Administration
pcf	Pounds Per Cubic Foot
psi	Pounds Per Square Inch
PVC	Polyvinyl Chloride
RJ	Restrained Joint
SDR	Standard Dimension Ratio
TDH	Total Dynamic Head
USDA	United States Department of Agriculture
EPA	United States Environmental Protection Agency
V	Volts
VCP	Vitrified Clay Pipe

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 16

FIELD QUALITY CONTROL PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Requirements for quality control, including testing for liquid-tightness (leakage testing) and settlement of concrete structures, as applicable to environmental engineering structures.
2. The work includes, but is not limited to:
 - a. Liquid-tightness testing of concrete containment structures.
 - b. Settlement testing and monitoring of structures.
 - c. Documentation and reporting of test results.

B. All Field Quality Control Testing shall be performed by Contractor or his Subcontractor. All cost for Field Quality Control Testing shall be included in the Contractor's base bid.

C. Water for filling structures for testing shall be provided by the Owner.

1. Temporary pumps, pipes, hoses, fittings, and other similar appurtenances required for filling the structures shall be supplied by the Contractor.

D. Repairs and retesting of tanks shall be accomplished at no additional cost to the Owner.

1.02 RELATED REQUIREMENTS

A. Related Specifications

1. Section 01 40 00 – Quality Requirements
2. Section 01 45 23 - Testing and Inspecting Services
3. Section 03 15 00 – Concrete Joints and Accessories
4. Section 03 30 00 – Cast-In-Place Concrete

1.03 REFERENCES

A. American Concrete Institute (ACI)

1. CI 350-20: Code Requirements for Environmental Engineering Concrete Structures
2. ACI 350.1-10: Specification for Tightness Testing of Environmental Engineering Concrete Structures

1.04 SUBMITTALS

A. Test Plan:

1. Submit a detailed plan for liquid-tightness testing and settlement monitoring, including methods, equipment, and schedule.
2. Include qualifications of testing personnel and calibration certificates for equipment.

B. Test Reports:

1. Submit reports for each test, including date, time, conditions, results, and any corrective actions taken.
2. Reports shall be signed by the contractor or subcontracting testing agency.

1.05 QUALITY CONTROL

- A. All test shall be conducted in the presence of the Engineer or his representative.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. Calibrate per manufacturer's recommendations
- B. Maintain current calibration records
- C. Equipment must be adequate for intended purpose

PART 3 - EXECUTION

3.01 LIQUID-TIGHTNESS TESTING.

A. General

1. Contractor shall perform liquid tightness (leakage) testing on all water containing structures.
2. Perform liquid-tightness testing in accordance with ACI 350.1 and as specified herein.
3. Testing shall be conducted after the structure has cured sufficiently and before backfilling or application of finishes.

B. Preparation

1. Clean the structure of debris, standing water, and foreign materials.
2. Seal all penetrations, outlets, and openings not intended for water flow.
3. Install temporary plugs or caps as necessary.

C. Testing Procedure

1. Fill structure to be tested to the normal operating liquid level. Filling rate shall not exceed 4' of water per hour and shall be at continuous uniform rate with continuous monitoring.

2. The exterior surface of the tank shall be monitored for flowing leaks. Repair any flowing leaks which occur before continuing filling.
3. The water shall be kept at the test level for at least 3 days prior to the actual test.
4. Measure the vertical distance to the water surface from a fixed point on the tank above the water surface. For large tanks and basins, a minimum of two measurement locations will be required to minimize effects of differential settling.
5. Record measurements at 24-hour intervals. The test shall be performed for a minimum of 3 days. Measurements must be taken at the same location each day.
6. Independently measure change in water volume due to evaporation and precipitation using a 24" deep white, watertight container not less than 10 square feet of surface area. Position the container to experience environmental conditions similar to the structure being tested. The volume change of the structure shall be corrected based on the water volume change in the sample container.
7. A drop of the water surface exceeding 1/10 of 1% of the normal volume of contained liquid will be considered failing.
8. The structure will have also been considered to have failed the test if flowing or seeping water is observed, or if moisture can be transferred to a dry hand from the exterior surface.

D. Documentation

1. Record daily measurements in inches and fractions (or hundredths) of an inch. The minimum measurement increment shall be small enough to accurately determine if a drop of 1/10 of 1% of the normal volume has been exceeded.
 - a. Each measurement record shall include:
 - 1) Measurement location
 - 2) Date and time
 - 3) Water temperature recorded at a depth of 18" below the water surface.
 - 4) Corrections for evaporation.
2. Record daily measurements of water level in evaporation container
3. All documentation must be submitted to the Engineer for review.

E. Test Failures

1. Failing tanks which exhibit no visible signs of leaking or seepage may be permitted to be immediately retested.
2. Failing tanks will be drained, repaired and retested until the tank has met the test requirements. Injection grouting or other similar methods of leak repair, that do not require tank draining, may be approved by the Engineer.

3. Methods for repairing concrete should be submitted as shop drawings for review by the Engineer.

3.02 SETTLEMENT TESTING

A. General

1. Contractor shall perform settlement testing on all liquid containing structures unless otherwise directed by the Engineer. Settlement testing shall be conducted in conjunction with Liquid Tightness Testing.
2. Precision surveying equipment such as engineer's level and grade rod or total station shall be used to measure elevations.

B. Testing Procedure

1. Establish monitoring points on the structure and record elevations based on an established benchmark prior to filling with water.
 - a. At minimum, one monitoring point shall be established at each corner of the structure.
2. After filling of structure is complete, measure elevations of each monitoring point daily until settlement has virtually ceased. Test shall be conducted a minimum of three days even if there is no apparent settlement.

C. Documentation

1. Record daily elevation reading to the nearest 1/100 of a foot. Each elevation record shall include the following:
 - a. Measurement location
 - b. Date and time
2. All documentation must be submitted to the Engineer for review.

D. Tolerances

1. Maximum allowable total settlement: 1 inch (0.083 ft)
2. Maximum allowable differential settlement: ½ inch (0.042 ft)

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes
 - 1. Temporary Construction Facilities
 - 2. Water for Construction
 - 3. Sanitary Facilities
 - 4. Construction Safety
 - 5. Security
 - 6. Temporary Parking

1.02 RELATED SECTIONS

- A. Section 31 25 00 Erosion and Sediment Control

1.03 SITE SECURITY AND PROTECTIVE WORK

- A. The Contractor shall furnish and install all necessary temporary works for the protection of the work and owner's property including, but limited to, fencing, barricades, warning signs and lights at night.

1.04 SAFETY AND OSHA REGULATIONS

- A. The performance of work under this Contract shall comply with safety regulations prescribed by the Owner, those of the National Occupational Safety and Health Act of 1970 as amended to date (PL 91-596), and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-054), and the requirements of the State where project is located. Contractor shall satisfy himself as to the character and extent of such regulations.

1.05 CONTACTOR'S LOCAL OFFICE

- A. The Contractor shall maintain a local office with a telephone in the general area of the work, and will be required to have a responsible representative on call at all times.
- B. Copies of drawings, specification, submittals, as-built drawings, and other similar contract documents shall be kept at the Contractor's local office and available for use at all times.

1.06 OFFICE SPACE AND FACILITIES FOR INSPECTORS

- A. The Contractor shall furnish proper and adequate office space and facilities for the use of the Engineer's Resident Inspectors. A separate office shall be provided at least 12' x 14' in a separate structure, equipped with lights, heat, and air conditioning.

- B. Access to office space shall include suitable stairs and landing areas at each exterior doorway.
- C. Inspection office must have access to a restroom equipped with potable water, toilet, sink, mirror, and waste basket. If office is provided as a separate structure from the Contractor's office, the restroom must be located in the Inspector's office building.
- D. Inspector's office shall be equipped with office 1-desk, 2-office swivel chairs with rollers, 2-four drawer lockable file cabinets, 1-plan rack, 1-plan table, 1-microwave, and 2-waste basket.
- E. Contractor shall provide toilet paper and paper towels for the Inspector's restroom.
- F. Contractor shall provide for weekly waste removal and cleaning of office space and restroom.
- G. Where connection to sanitary sewer is not available, pumpable holding tanks shall be provided by the Contractor. Sanitary holding tanks must be pumped on a minimum biweekly basis.
- H. All cost associated with the Inspection Office shall be paid for by the Contractor.

1.07 SANITARY FACILITIES

- A. Contractor shall provide temporary sanitary facilities at the site for the needs of all construction workers and other personnel on the site.
- B. Sanitary facilities shall be provided in adequate capacity for the project work force and properly maintained throughout the construction period.
- C. Sanitary facilities shall be obscured from public view to the greatest practical extent.
- D. Contractor shall enforce the use of sanitary facilities by all personnel at the site.
- E. Use of the owner's sanitary facilities is prohibited.

1.08 STORAGE FACILITIES AND LAYDOWN AREAS

- A. Should the Contractor so desire, he may build storage facilities or other structures for housing men, tools, machinery and supplies, but they will be permitted only at approved places, and their surroundings shall be maintained at all times in a neat and sanitary and satisfactory manner to comply with the regulation of the State Board of Health and all local ordinances. No nuisance will be permitted.
- B. On or before the completion of the work, all such storage structures shall be removed, together with all rubbish and trash, at the expense of the Contractor
- C. Laydown areas for equipment and material must be located in areas approved by the owner. Laydown areas shall not block access to owner's equipment or facilities. Material exposed to weather must be protected as recommended by the manufacturer.

1.09 WATER

- A. If available, all water required for construction will be supplied by the Owner in the vicinity of the site. The contractor must provide a water meter suitable to the owner and track all water usage to the nearest 1,000 gallons.
- B. Contractor shall procure water only in the locations designated by the Owner or Engineer.

- C. Contractor at its own expense shall make authorized connections to provide temporary water for the site including, but not limited to, taps, pumping equipment, temporary piping, backflow prevention (when required by the owner).
- D. Contractor shall provide adequately against waste and needless use of water.
- E. Contractor shall pay for water required for retest of basins or piping due to improper construction.

1.10 POWER AND FUEL SUPPLY

- A. Contractor shall provide all power and fuel required for construction operations.
- B. Temporary service poles, meters, electrical panels, and other similar shall be provided as required. Location of temporary services must receive prior approval from the Engineer. Temporary services shall be removed upon completion of the project.

1.11 ROADS AND PARKING AREAS

- A. Streets, roads and drives used by the Contractor for access to and from the site of his work shall be protected from damage in connection with construction work. Any such damage done shall be repaired immediately and left in good condition at the end of the construction period.
- B. Contractor shall construct temporary roads and parking areas as required for construction access with approval from Engineer. Upon completion of the project, areas of temporary roads and parking shall be returned to their original condition or as noted on the site plan.
- C. Contractor must park equipment and vehicles in a safe manner off all travel lanes if possible. Contractor's parking shall not block access to owner's equipment or facilities.
- D. At least one designated parking space for the Resident Inspector shall be provided near the Inspector's office space.

1.12 DUST AND MUD CONTROL

- A. Contractor shall take measures to prevent the dispersal of dust from the site and tracking of mud onto public streets, drives, and sidewalks.
- B. All egress from the site shall be maintained in a dry condition and any mud tracked onto streets, sidewalks, and drives shall be immediately removed and the affected area cleaned.
- C. Where vehicles will leave a muddy site and enter paved roads, the Contractor shall maintain a suitable wheel-washing facility and crew. All trucks and other vehicles leaving the site shall be cleaned of mud and dirt.
- D. Contractor shall provide dust control at all times, including holidays and weekends, as required to abate nuisance dust on or near the site that results from construction activity. Where earthwork operations are in progress, exposed surfaces shall be continually kept damp.
- E. Where dust resulting from construction activities has collected on public sidewalks and streets, hose down such sidewalks and streets to abate flying dust particles. Clean all sidewalks and streets from accumulated dirt and dust.

1.13 SOIL EROSION AND SEDIMENT CONTROL

- A. The Contractor shall be required to take the necessary steps to minimize siltation and soil erosion during construction. The Contractor shall utilize best management practices (BMPs) as shown and in accordance with the Manual for Erosion and Sediment Control in Georgia, as amended to date.
- B. A copy of the approved Erosion and Sediment Control Plan must be kept in the Contractor's Local Office.
- C. Erosion and Sediment Control BMPs must installed prior to initiation of construction activity.
- D. Refer to Section 31 25 00 Erosion and Sediment Control

1.14 STORMWATER MONITORING

- A. If required, the Contractor shall measure rainfall and perform inspections and sample discharges in accordance with NPDES Stormwater Discharges Associated with Construction Activities, General Permit (GAR 100001, 100002, 100003).

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 61 00

COMMON PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for product delivery, storage, and handling
2. General product requirements and quality assurance
3. Product options and substitutions
4. System compatibility requirements
5. Spare parts and maintenance materials

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 25 00 - Substitution Procedures
2. Section 01 33 00 - Submittal Procedures
3. Section 01 40 00 - Quality Requirements
4. Section 01 77 00 - Closeout Procedures
5. Section 01 78 23 - Operation and Maintenance Data

1.03 DEFINITIONS

- A. **Products:** Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
- B. **Named Products:** Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents
- C. **Comparable Product:** Product that is demonstrated and accepted through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- D. **Standard Products:** Products manufactured according to industry standards.

- E. System Compatibility: Ability of components to work together as a complete, functioning system.
- 1.04 SUBMITTALS
- A. Submit in accordance with Section 01 33 00
 - B. Action Submittals:
 - 1. Product List: Contractor shall submit list of major products proposed for use, including the following information:
 - a. Manufacturer's name and model number
 - b. Specification section reference
 - c. Drawing reference
 - d. Description of the intended use
 - 2. Product Data: As specified in individual sections
 - C. Informational Submittals:
 - 1. Manufacturer's Instructions
 - 2. Source Quality Control Reports
 - 3. Field Quality Control Reports
 - 4. Warranty Documentation
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications:
 - 1. Company specializing in manufacturing products specified
 - 2. Minimum five years documented experience
 - 3. ISO 9001 certification where applicable
 - B. Source Limitations:
 - 1. Obtain products through one source from single manufacturer
 - 2. Provide products of same kind from single source
 - 3. When specified products are available only from limited sources, provide written notification
 - C. Regulatory Requirements:
 - 1. Comply with applicable codes and regulations
 - 2. Provide products listed and labeled by UL or testing agency
 - 3. Meet requirements of authorities having jurisdiction

D. Industry Standards:

1. Comply with specified reference standards
2. Use most current version of standards unless noted otherwise
3. Report conflicts between standards and contract documents

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS

A. General Product Requirements: Unless otherwise indicated in the Contract Documents, furnish materials and equipment as follows:

1. Furnish new products unless specifically required or permitted otherwise
2. Furnish products compatible with other products used on the project.
3. Provide products with accessories, trim, finish, and other devices as required for a complete installation.

B. Product Selection:

1. Provide products that comply with Contract Documents
2. Match products previously selected when only one product named
3. Provide products indicated by reference standards
4. Use products specified by performance requirements

C. System Compatibility:

1. Provide products of same manufacturer for components of major systems.
2. Verify compatibility between all system components.
3. Identify potential conflicts before installation. The Engineer shall be notified of any conflicts or deviations identified.
4. Submit coordination drawings where required for installation.

2.02 FABRICATION

A. General Requirements:

1. All equipment, material, and products shall be fabricated to appropriate tolerances as set forth in the specifications or industry standards.
2. Products shall be provided with a uniform appearance. Variations in color, texture, or other similar features will not be accepted unless it is specified as part of the design.
3. Contractor shall be responsible for coordinating all dimensions and attachment methods.

4. Equipment, materials, and products shall be factory-assembled as much as practicable.

B. Shop Assembly:

1. Comply with manufacturer's instructions
2. Use qualified personnel and proper equipment
3. Match-mark units for field assembly
4. Trial fit assemblies where specified

2.03 SOURCE QUALITY CONTROL

A. Testing and Inspection:

1. Perform factory tests as specified
2. Allow Owner's or Engineer's representative access to manufacturing facilities when requested.
3. Certified test reports, when required, shall be provided prior to shipping
4. Submit quality control procedures

2.04 FACTORY CERTIFICATION:

1. Provide manufacturer's certification of compliance
2. Include test results and inspection reports
3. Maintain records of quality control tests

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. General:

1. Equipment and materials must be delivered, offloaded and stored according to manufacturer's recommendations and subject to the contractor's oversight and protection, insuring said products until project completion.
2. Contractor shall ensure the shipping, delivery, storage and retrieval of all equipment and materials in like new condition.

B. Delivery:

1. Contractor shall make weekly delivery schedules available to the Owner and Engineer.
2. Equipment deliveries shall be scheduled and coordinated by the Contractor to:
 - a. Minimize storage time requirements and site congestion.

- b. Minimize impact on work progress.
 - c. Minimize interference with Owner's operations.
- 3. Products shall be delivered in manufacturer's original containers.
- 4. Products must be appropriately labeled for easy identification. Labels must not be hidden, obscured or difficult to access.
- 5. Upon delivery, the Contractor shall inspect materials and equipment for damage and compliance with the contract documents and approved submittals.
- 6. Each delivery must be accompanied with sufficient and appropriate documentation such as bill of lading, packing list, shipping manifest, delivery receipts, and inspection reports, as appropriate for the equipment or materials being delivered.
- 7. The Contractor shall maintain detailed records on all deliveries related to the project.

C. Storage:

- 1. Store all equipment, materials, and products according to the manufacturer's recommendations in like new condition for incorporation into the work.
- 2. All equipment, material, and products must be stored and protected from the elements.
 - a. Sensitive products shall be stored in weather-tight enclosures with temperature and humidity control provided where needed.
 - b. Storage methods must protect the products from heat, cold, humidity, precipitation, and UV radiation.
- 3. All equipment, materials, and products shall be stored in locations to prevent damage or theft. The Contractor shall utilize protective barriers and other similar measures as required to protect from vehicles or other site activities.
- 4. Products must be stored in manners that do not affect their appearance, function, useful life, or warranty.
- 5. All stored materials must be made available for inspection during working hours.
- 6. All equipment and materials that are claimed on the Contractor's Stored Material List, must be stored on the Owner's property unless otherwise approved by the Engineer.

D. Handling:

- 1. All equipment and materials shall be handled according to the manufacturer's instructions.
- 2. Use proper handling equipment and techniques to allow installation without damaging the products.
- 3. Product finishes must be protected from damage during handling. Protective films, cushions, or wraps provided by the manufacturer shall remain in place for as long as practicable.

3.02 INSTALLATION

A. General Requirements:

1. All equipment and materials shall be installed according to the manufacturer's instructions.
2. Contractor shall utilize skilled workers for the installation of all equipment, materials and products.
3. Installation of equipment and material shall comply with specified or industry standards
4. Contractor shall maintain proper site and safety conditions during installation.

B. Tolerances:

1. Install products to tolerances as indicated in the specifications. Where tolerances are not noted, comply with industry standards.
2. The Contractor shall coordinate tolerances between all components.
3. The Contractor shall verify all dimensions prior to fabrication.
4. Contractor or Manufacturer's representative shall adjust all equipment and materials as required for proper operation.

3.03 PROTECTION

A. Installed Products:

1. Installed products shall be protected and kept in like new condition until completion and acceptance by the Engineer and Owner.
2. The Contractor shall maintain manufacturer's required conditions.
3. The Contractor shall replace damaged products at no additional cost to the Owner.
4. Remove protection at completion

B. Adjacent Construction:

1. Contractor shall protect existing facilities, equipment, and other work during delivery, storage, handling, and installation.
2. The Contractor shall repair damage to adjacent materials at no additional cost to the Owner.
3. The Contractor shall clean all surfaces affected during delivery, storage, handling, or installation of materials.
4. Any damaged surfaces shall be restored to original condition.

3.04 MAINTENANCE

A. Extra Materials:

1. Provide spare parts as specified
2. Deliver to location designated by Owner

3. Package with protective covering
4. Label clearly with:
 - a. Part numbers
 - b. Product identification
 - c. Installation location
 - d. Shelf life/expiration date

B. Maintenance Instructions:

1. Provide manufacturer's maintenance instructions to include:
 - a. Inspection procedures
 - b. Maintenance schedule
 - c. Repair instructions
 - d. Replacement parts list

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Procedural requirements for project closeout

1.02 RELATED DOCUMENTS

A. Related Specifications

1. Section 00 72 00 – General Conditions
2. Section 00 73 00 – Supplementary Conditions
3. Section 01 00 00 – Summary of Work
4. Section 01 33 00 – Submittal Procedures
5. Section 01 29 02 – Measurement and Payment
6. Section 01 40 00 - Quality Requirements
7. Section 01 45 16 – Field Quality Control Procedures
8. Section 01 61 00 – Common Product Requirements
9. Section 01 77 00 - Closeout Procedures
10. Section 01 78 23 - Operation and Maintenance Data
11. Section 01 78 39 - Project Record Documents
12. Section 01 79 00 – Demonstration and Training

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 30 00**
- B. Closeout Schedule:** Submit proposed schedule for closeout activities at least 30 days prior to substantial completion.
- C. Commissioning Reports:** Submit preliminary and final commissioning reports for water treatment systems, including performance testing results, to EPD for approval.
- D. Compliance Documentation:** Provide copies of documents required by the Governing Authorities including, but not limited to:
1. Startup reports

2. Disinfection records and Bacteriological testing
 3. Pressure testing
 4. Operational certifications
- E. Training Documentation: Certificates of completion for Owner's personnel training on water treatment operations including videos, minutes, sign-in sheets, and other similar information.
- 1.04 SUBSTANTIAL COMPLETION
- A. Substantial Completion shall be as defined in the General Conditions.
 - B. When the Contractor considers the work to be Substantially Complete for its intended use, Contractor shall notify the Engineer in writing as defined in the General Conditions.
 - C. Upon receipt of the Contractor's notice of Substantial Completion:
 1. The Engineer and Owner will conduct a site inspection and issue a Punch List of Items required for Final Completion in accordance with General Conditions.
 2. The Engineer will notify the Owner of the Date of Substantial Completion if the project is determined to be Substantially Complete.
 - D. For additional information on Substantial Completion, refer to Article 15.03 of the General Conditions (00 72 00)
- 1.05 FINAL CLEANING
- A. Provide final cleaning prior to final project assessment
 - B. Clean all exposed surfaces and polish all transparent and glossy surfaces.
 - C. Remove all temporary labels, protective films, stains, and foreign substances.
 - D. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate for the surface and material being cleaned.
 - E. Clean or Replace filters of operating equipment.
 - F. Clean debris from all basins, roofs, gutters, downspouts, and drainage systems.
 - G. Clean site, sweep paved areas, and rake clean landscaped surfaces
 - H. Remove waste, surplus materials, and rubbish from the site.
- 1.06 ADJUSTING
- A. Adjust operating products or equipment to ensure smooth and unhindered operation
- 1.07 DEMOBILIZATION
- A. Remove all temporary construction offices and storage facilities.
 - B. Remove all construction equipment and tools from site.

- C. Return all temporary spoil areas or lay down yards to preconstruction conditions or as otherwise noted on the drawings.

1.08 FINAL COMPLETION

- A. Contractor shall notify the Engineer in writing when all Punch List Items have been completed.
- B. After notification, the Engineer will conduct a final project assessment and notify the Contractor over any deficiencies or incomplete work.
- C. Upon completion of all work, the Engineer will notify the Owner of Date of Final Completion.
- D. Refer to Articles 15.05 and 15.06 of the General Conditions for additional information on Final Inspection and Final Payment and any modifications made in Supplemental Conditions (00 73 00).

1.09 FINAL LIEN RELEASE

- A. Prior to final payment, the Contractor shall provide a notarized Final Lien Waiver that includes the following:
 - 1. Contractor certifies that Contractor is in full compliance with the Contract.
 - 2. Contractor acknowledges upon receipt in full of payment for all services, materials and work rendered or furnished by Contractor under the Contract, and does hereby voluntarily waive and release all liens, claims and demands of any and every kind or character which Contractor now has or may have in the future on or upon the Property and/or against Owner for work done, labor performed and/or materials furnished by Contractor in connection with the Contract (hereinafter the "Services Rendered").
 - 3. Contractor agrees and warrants:
 - a. That there are no outstanding mechanic's, materialman's, or laborer's liens against the Property arising out of or in connection with the Services Rendered, and no claims outstanding which would entitle the holder thereof to claim a mechanic's, materialman's or laborer's lien against the Property.
 - b. That all vendors, subcontractors, materialmen, laborers and any other person having a claim for work done, labor performed and/or materials furnished in connection with the Services Rendered have been fully paid and have no claim or lien against Owner or the Property.
 - c. That all related Sales and Use taxes, Social Security taxes, Income taxes, Unemployment Taxes, Privilege taxes, License fees, and any other taxes and obligations imposed by governmental authorities in connection with the Services Rendered have been fully paid to the appropriate authorities.
 - d. That Contractor will indemnify and hold Owner harmless from and against any and all losses, costs, damages and expenses of each and every kind, including attorney's fees, which Owner may suffer or incur, whether directly or indirectly, which arise out of or in connection with any claims for unpaid amounts by vendors, subcontractors, materialmen, laborers or others who furnished labor, materials or services on, or about or to the Property or Owner in connection with the Services Rendered

1.10 PROJECT RECORD DOCUMENTS

- A. Refer to Section 01 78 39, Project Record Documents

1.11 OPERATION AND MAINTENANCE DATA

- A. Refer to Section 01 78 39, Operation and Maintenance Data

1.12 FINAL PAYMENT

- A. Refer to Article 15.06 of the General Conditions (00 72 00) and any modifications made in Supplemental Conditions (00 73 00)

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Format and content of operation and maintenance manuals
2. Schedule of submittals
3. Assembly and submission requirements

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 33 00 - Submittal Procedures
2. Section 01 77 00 - Closeout Procedures
3. Section 01 78 39 - Project Record Documents

1.03 SUBMITTALS

A. Initial Submittal:

1. Submit and electronic copy of each manual at least 60 days before requesting inspection for Substantial Completion.
 - a. Equipment installation and startup procedures, if not included in the equipment submittal, must be provided prior to the equipment startup.
2. Include complete operation and maintenance directory
3. Engineer will review and note any corrections or additional information required for the Final Submittal.

1.04 FINAL SUBMITTAL:

1. Within 10 days of final project inspection, the Contractor shall submit the final volumes of each Operation and Maintenance Manual in the following formats:
 - a. Three (3) bound hard copies
 - b. Digital copy in PDF format on USB Drive. The PDF file shall be word searchable and bookmarked for major sections.

2. Final O&M Manuals must be received before final payment is authorized.

1.05 QUALITY ASSURANCE

A. Source Documentation:

1. Operation and Maintenance data must be provided by the original equipment manufacturer.
 - a. O&M data for system components such motors, gearboxes, control panels, and other similar products, not manufactured by the System Supplier/Manufacturer, must be included in the manual.
2. The Contractor shall review documents for completeness and accuracy prior to submitting to the Engineer.
3. The Contractor shall verify documents match installed equipment and provide as-built drawings where required.

B. Document Preparation:

1. Manuals shall be prepared by personnel experienced in maintenance and operation of described products.
2. Manuals shall use clear and concise language.

PART 2 - PRODUCTS

2.01 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- ##### A. General:
- The Contractor shall provide a directory of all Operation and Maintenance Manuals provided for the project.

B. Directory Organization:

1. List systems alphabetically
2. Include emergency information at front of manual
3. Provide table of contents for each volume

C. Directory Content:

1. List of documents
2. List of systems and subsystems
3. Names, addresses, and contact information for Contractors, suppliers, and manufacturers

2.02 MANUALS, GENERAL

A. Organization:

1. Title page with project name

2. Table of contents
3. Manual contents

B. Format:

1. Heavy-duty, 3-ring binders
2. Face spine labeled with project name and volume number
3. Text: Manufacturer's printed data or typewritten
4. Drawings: Attach reinforced punched binder tabs
5. Digital Copy: Bookmarked PDF format and word searchable on portable USB drive.

2.03 OPERATION MANUALS

A. Content:

1. Description of system and component parts
2. Operating procedures
3. Safety precautions
4. Operator servicing requirements
5. Control sequences
6. Emergency instructions

B. Operating Procedures:

1. Startup, break-in, routine, and normal operating instructions
2. Regulation, control, stopping, and emergency instructions
3. Summer and winter operating instructions
4. Special operating instructions

2.04 MAINTENANCE MANUALS

A. Content:

1. Maintenance procedures and guides
2. Preventive maintenance procedures
3. Troubleshooting guides
4. Parts identification
5. Wiring diagrams

6. List of all recommended lubricants where applicable.
7. Maintenance schedules

B. Maintenance Procedures:

1. Test and inspection instructions
2. Troubleshooting guide
3. Disassembly, repair, and reassembly instructions
4. Alignment, adjusting, and checking instructions

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents.

1.02 RELATED REQUIREMENTS:

A. Related Specifications

- 1. Section 01 77 00 - Closeout Procedures
- 2. Section 01 78 23 - Operation and Maintenance Data

B. Individual Specification Sections

1.03 MONTHLY REVIEW

- A. The Contractor shall make record drawings available for review by the Engineer's or Owner's representatives at all times.
- B. Prior to each monthly pay application, the Engineer's representative shall review the record (as-built) drawings to ensure that all claimed work has been accurately recorded.

1.04 CLOSEOUT SUBMITTALS

A. Record Drawings:

- 1. Submit one set of marked-up, record (as-built) drawings
- 2. Submit PDF electronic files of scanned record prints
- 3. All drawing sheets and files must be included whether or not changes or additional information were recorded.

B. GPS Data

- 1. Collected GPS data must be submitted in a raw data format file, including an export of data to a .txt or .csv file in the format of northing, easting, elevation, and description coordinates.

1.05 RECORD DRAWINGS

A. General

- 1. Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

2. Contractor must present as-builts on a clean set of Drawings. All as-builts must be neat and legible. Revision or detail drawings, if required, may be included as additional sheets to plan set.
3. Mark record prints to show actual installation
4. Keep record documents current and consistent with the progress of work.
5. Give particular attention to information on concealed elements
6. Accurately record information in an acceptable drawing technique
7. Record and check markup before enclosing concealed installations
8. Changes shall be clearly marked using red ink or pencil.

B. Content:

1. Any deviations to the contract drawings
2. Additional details not on original Contract Drawings
3. Depths and locations of foundations below first floor or base slab.
4. Locations and depths of utilities buried underground or concealed in concrete.
5. Revisions to routing of piping and conduits
6. Revisions to electrical circuitry
7. Actual equipment locations
8. Duct size and routing
9. Locations of concealed internal utilities
10. Changes made by change orders, field orders, work directives or submittals

C. Additional Requirements for Utilities

1. All new buried utilities and other similar items will be located with a minimum of two distances from permanent points or by GPS coordinates meeting the requirements of these Specifications to all intersections, changes in direction and appurtenance locations. Any statement such as "Installed Per Plans" shall not relieve Contractor of these requirements.
2. Utilities to be located include, but are not limited to, pipes, conduits, duct banks, wires, cables, fiber optic and other similar items.
3. Appurtenances requiring location include, but are not limited to, manholes, fire hydrants, fittings, water taps, sewer taps, meters, valves, clean-outs, junction boxes, pull boxes, hand holes, and other similar items.
4. A distance from centerline of road is required for all new water and sewer lines every 100'.

5. The location of utilities installed below slabs or encased in concrete must be accurately dimensioned on the structure plans and sections.
6. Provide ground elevation, top elevation and all invert elevations for each manhole, drop inlet, junction box, and other similar structures.
7. For force mains or other pipes shown in a profile view, provide ground elevation and invert elevation at all high points, low points and change of slope. Additional elevations may be required to verify positive slope.
8. Utilities shall not be covered until as-built information has been recorded

1.06 MAINTENANCE OF RECORD DOCUMENTS

A. Storage:

1. Maintain documents in clean, dry, legible condition
2. Store in field office apart from documents used for construction
3. Provide files and racks for storage

B. Maintenance:

1. Do not use Record Documents for construction purposes
2. Maintain Record Documents in good order
3. Make entries within 24 hours of completion of work requiring a record of change.

1.07 GPS DATA COLLECTION

A. General:

1. Unless otherwise instructed by the Engineer, the Contractor shall provide GPS data on all new utilities and appurtenances as defined in the previous sections
2. GPS field work must be performed by personnel that are trained in the use of GPS equipment. If needed, Contractor may subcontract with a surveyor to provide the required data.
3. The GPS receiver must be mapping grade or better. Survey or high accuracy grade receivers may be required to achieve tolerances noted in the following section of these Specifications. Recreational grade units, including smart phones and tablets, are not acceptable.

B. Spatial Reference:

1. Units: US Survey Feet
2. Horizontal Datum: State Plane Coordinates (Geographic zone where project is located)
3. Vertical Datum: North American Vertical Datum (NAVD) 1988

1.08 DIMENSION TOLERANCES FOR AS-BUILT DRAWINGS AND DATA

- A. Dimensions provided on as-built drawings, whether measured by GPS or conventional methods, shall meet the following requirements:

<i>Project Type or Structure</i>	<i>Horizontal (X,Y)</i>	<i>Vertical (Z)</i>	<i>Minimum GPS Grade</i>
Water Lines and Appurtenances	<1'	<0.10'*	Mapping
Sewer Lines and Appurtenances (See manholes below)	<1'	<0.10'*	Mapping*
Force Mains and Appurtenances	<1'	<0.10'*	Mapping*
Storm Drains and Appurtenances	<1'	<0.10'*	Mapping*
Roadways, Sidewalks and Similar	<1'	<0.10'*	Mapping*
Location of Building and Structures	<1'	<0.05'	Survey
Actual Dimensions of Buildings and Structures and Finished Floor Elevations	<¼"	<0.01'*	Survey
Temporary Benchworks		<0.01'	Survey
Manhole and Wetwell Inverts and Rim Elevations	<1'	<0.01'*	Survey
Weirs and Other Critical Elevations	<1'	<0.01'*	Survey

** Where vertical tolerance exceeds mapping grade, elevations must be supplemented by differential leveling using surveyor's level and grade rod.*

***Tolerances are for recording purposes only; actual construction may require closer tolerances than those noted.*

PART 2 - PRODUCTS

2.01 ELECTRONIC FILE REQUIREMENTS

- A. File Format:
1. PDF format, with text recognition enabled
 2. Bookmarked for easy navigation
 3. Resolution minimum 300 dpi
 4. Hyperlinked cross-references

PART 3 - EXECUTION

3.01 RECORDING:

- A. Maintain one copy of each submittal during construction

1. Post changes and revisions to documents as they occur
2. Record information concurrent with construction progress

B. Document Control:

1. Assign responsible person for maintaining Record Documents
2. Implement log-in/log-out system for document control
3. Review documents monthly with Engineer's representative
4. Certify completeness of records prior to submittal

3.02 FINAL DOCUMENT PREPARATION

A. Prior to submission:

1. Review for completeness and accuracy
2. Verify all markups have been converted to clean, final record drawings
3. Verify electronic files are complete and properly formatted
4. Verify all documents are properly indexed and bookmarked

3.03 DOCUMENT TURNOVER:

1. Submit all required copies in specified formats
2. Obtain receipt from Owner/Engineer
3. Include transmittal documenting information delivered
4. Provide training on electronic document navigation if requested.

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for:
 - 1. Demonstration of operation of systems, subsystems, and equipment
 - 2. Training of Owner's personnel in operation and maintenance
 - 3. Demonstration and training video recordings
 - 4. Closeout documentation requirements
- B. Training shall be required for the following:
 - 1. SCADA
 - 2. Major Mechanical Equipment
 - 3. Security Systems
 - 4. Biological Processes and all Complex Systems
 - 5. Other Systems where required by the plans, specifications or manufacturer recommendations

1.02 RELATED DOCUMENTS

- A. Related Specifications
 - 1. Section 01 77 00 - Closeout Procedures
 - 2. Section 01 78 23 - Operation and Maintenance Data
 - 3. Section 01 78 39 - Project Record Documents
 - 4. Division 26 - Electrical Systems
 - 5. Division 46 – Water Equipment

1.03 INFORMATIONAL SUBMITTALS

- A. Instruction Program:
 - 1. Submit outline of instructional program
 - 2. Include schedule of proposed dates, times, length of instruction
 - 3. Include learning objectives and outline for each training module

4. Include training module descriptions
5. Include qualifications of instructors

B. Attendance Record:

1. For each training module, submit list of participants
2. Include sign-in sheets
3. Include training certification forms

C. Video Recordings:

1. Submit two copies within seven days of end of each training module
2. Identification on each recording
3. Digital file format acceptable to Owner

1.04 QUALITY ASSURANCE

A. Facilitator Qualifications:

1. Firm or individual experienced in training
2. Familiar with installation and operation
3. Minimum five years documented experience
4. Knowledge of Owner's operational requirements

B. Instructor Qualifications:

1. Factory-authorized service representatives
2. Experienced in operation and maintenance procedures
3. Comprehensive knowledge of systems
4. Proficient in instruction techniques

1.05 COORDINATION

A. Coordinate instruction schedule with Owner's operations

1. Adjust schedule as required
2. Notify Owner minimum of seven days advance
3. Coordinate with equipment startup

B. Coordinate content of training modules with:

1. Operation and maintenance manuals

2. Record documents
3. Equipment warranties
4. System testing and commissioning

PART 2 - PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure:

1. Module outline for each system
2. Assembly of modules for complete system training
3. Training modules corresponding to systems
4. Critical operating scenarios

B. Training Modules:

1. System Description:
 - a. Review system documentation
 - b. Design intent and criteria
 - c. Performance requirements
 - d. Warranties and service agreements
2. Documentation:
 - a. Review operations manual
 - b. Review maintenance manual
 - c. Review project record documents
 - d. Review warranties and bonds
3. Operations:
 - a. Startup procedures
 - b. Routine operations
 - c. Normal shutdown
 - d. Emergency shutdown
 - e. Seasonal operations

- f. Required sequences
 - g. Special operating instructions
- 4. Adjustments:
 - a. Alignments
 - b. Checking adjustments
 - c. Noise and vibration adjustments
 - d. Economy and efficiency adjustments
- 5. Troubleshooting:
 - a. Diagnostic instructions
 - b. Common system problems
 - c. Corrective actions
 - d. Emergency procedures
- 6. Maintenance:
 - a. Inspection procedures
 - b. Preventive maintenance
 - c. Cleaning methods
 - d. Lubrication schedules
 - e. Parts identification

2.02 TRAINING MATERIALS

A. Training Manual:

- 1. Bound copies for each participant
- 2. Include training module outline
- 3. Include detailed instructor notes
- 4. Include handouts and visual aids

B. Visual Aids:

- 1. PowerPoint presentations
- 2. System diagrams
- 3. Equipment cutaways

4. Demonstration equipment

PART 3 - EXECUTION

3.01 PREPARATION

- A. Assemble educational materials:
 1. Training manuals
 2. Operating manuals
 3. Maintenance manuals
 4. Project record documents
 5. Testing and balancing reports
 6. Verify equipment readiness:
- B. Complete system startup
 1. System is operating
 2. Safety devices are installed
 3. Equipment is accessible

3.02 INSTRUCTION

- A. Scheduling:
 1. Provide instruction at mutually agreed times
 2. For equipment requiring seasonal operation, provide similar instruction
 3. Schedule training with Owner with minimum seven days advance notice
- B. Training Location and Reference Material:
 1. Conduct training on-site in completed installation
 2. Use actual equipment installed
 3. Review operation and maintenance manuals
 4. Review record documents
- C. Training Format:
 1. Classroom Phase:
 - a. Overview of system

- b. Theory of operation
 - c. Design parameters
 - d. Safety procedures
 - 2. Hands-on Phase:
 - a. Startup and shutdown
 - b. Operation procedures
 - c. Adjustment procedures
 - d. Troubleshooting
 - e. Maintenance procedures
- 3.03 DEMONSTRATION
- A. Equipment Demonstration:
 - 1. Demonstrate operation of each system
 - 2. Demonstrate all operational modes
 - 3. Demonstrate emergency operations
 - 4. Demonstrate safety features
 - B. System Integration:
 - 1. Demonstrate interface with other systems
 - 2. Demonstrate control sequences
 - 3. Demonstrate alarms and responses
- 3.04 VIDEO RECORDING
- A. General:
 - 1. Record each training module separately
 - 2. Include classroom and hands-on instruction
 - 3. Include demonstration of procedures
 - B. Video Recording Format:
 - 1. Digital video format acceptable to Owner
 - 2. High-quality resolution
 - 3. Camera movement to follow action

4. Adequate lighting for clear video

C. Recording Content:

1. Identification at beginning:
 - a. Project name
 - b. Project number
 - c. Date of recording
 - d. Training topic
 - e. Instructor's name
2. Include:
 - a. Clear view of instructor
 - b. Clear audio of instruction
 - c. Close-up views of equipment
 - d. Split screen where beneficial

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure
2. Demolition and removal of selected site elements
3. Salvage of existing items to be reused or recycled
4. Protection of adjacent structures and utilities

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 1. Section 01 11 00 – Summary of Work
 2. Section 31 10 00 - Site Clearing

1.03 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

1.04 MATERIALS OWNERSHIP

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

1.05 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished
 - 2. Review structural load limitations of existing structure
 - 3. Review and finalize selective demolition schedule
 - 4. Review requirements of work performed by other trades
 - 5. Review areas where existing construction is to remain and requires protection

1.06 SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities:
 - 1. Detailed sequence of selective demolition and removal work
 - 2. Interruption of utility services
 - 3. Coordination for shutoff, capping, and continuation of utility services
 - 4. Use of elevator and stairs
 - 5. Coordination of Owner's continuing occupancy of portions of existing building
- D. Pre-demolition Photographs: Show existing conditions of adjoining construction and site improvements. Submit before work begins.

1.07 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.08 FIELD CONDITIONS

- A. If owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, proceed according to regulatory guidance and Contractor's written policy unless directed otherwise by Engineer or Jurisdictional Authorities. Inform Engineer of any such determination.
 - E. Storage or sale of removed items or materials on-site is not permitted.
 - F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- 1.09 WARRANTY
- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.
- 1.10 PERFORMANCE REQUIREMENTS
- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
 - B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- C. Survey of Existing Conditions:
 1. Survey existing material and equipment for the presence of unsafe conditions. Neither the Owner nor Engineer are safety engineers. Proceed according to regulatory guidance or Contractor's written policies unless directed otherwise by Jurisdictional Authorities or the Engineer. Inform Engineer of any such determination.
 2. Record existing conditions by use of preconstruction photographs.

3.02 PREPARATION

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

1. Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
2. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

3.03 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.04 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations.
- B. Site Access and Temporary Controls:
 1. Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.
- D. Removed and Salvaged Items:
 1. Clean salvaged items
 2. Pack or crate items after cleaning
 3. Identify contents of containers
 4. Store items in a secure area until delivery to Owner
- E. Removed and Reinstalled Items:
 1. Clean and repair items to functional condition adequate for intended reuse
 2. Pack or crate items after cleaning and repairing
 3. Identify contents of containers
 4. Protect items from damage during transport and storage
 5. Reinstall items in locations indicated

3.05 CLEANING

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas
 - B. Burning: Do not burn demolished materials.
 - C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.
- 3.06 SELECTIVE DEMOLITION SCHEDULE
- A. As shown on the drawings or specified.

END OF SECTION

SECTION 03 01 30

CONCRETE REHABILITATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Repair procedures for use on existing concrete structures categorized based on depth and extent of damage.
2. This section does **not** address pre or post tensioned concrete structures, duct, or equipment anchorage repairs.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Proposal form with units of measure and predefined quantities of repairs
- C. Related Specifications
 1. Section 03 30 00 - Cast-in-Place Concrete
 2. Section 03 62 00 – Non-Shrink Grouting

1.03 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete
2. ACI 562-21 Code Requirements for Assessment, Repair and Rehabilitation of Existing Concrete
3. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures
4. ACI 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete
5. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials

B. ASTM International:

1. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
2. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars
3. ASTM C191 - Test Methods for Time of Setting of Hydraulic Cement

1.04 SUBMITTALS

A. PRODUCT DATA:

1. Contractor may propose products that differ from this specification. Engineer will review and may accept such differing products on a case-by-case basis.
2. Documentation of compliance with ACI 562-21 Code Requirements for Assessment, Repair and Rehabilitation of Existing Concrete requirements
3. Qualification data per ACI 355.4 for adhesive anchors

B. CATEGORIZING CONCRETE DAMAGE:

1. Minor Spalls:
 - a. Damage is less than 1 inch deep and covers an area less than 12 square inches. However, if reinforcing bar(s) are exposed, the spall is classified as "Intermediate" even if less than 1" deep.
 - b. The contractor may designate a repair covering more than 12 square inches as a Minor Spall per acceptance by the Engineer.
2. Intermediate Spalls:
 - a. The damage exposes the underlying rebar or depth is greater than one inch, and less than six inches.
 - b. No significant stresses are likely to develop in or immediately around the repair due to structural or service loads.
3. Major Spall:
 - a. Damage extends beyond underlying reinforcement, exposing the circumference of rebar.
 - b. Significant stresses are likely in or immediately around the repair material due to structural or service loads.
4. Cracks
 - a. Cracks that are significant or are likely in or immediately around the repair material due to structural or service loads shall be repaired as Intermediate or Major Spalls.
 - b. Cracks not so designated shall be injected with an epoxy manufactured and marketed for that purpose using manufacturer's suggested injection tools and performed by manufacturer certified installers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Proprietary repair materials must be delivered in the original, unopened containers with labels intact identifying product and manufacturer. The date of manufacture must be clearly marked.
2. Non-Proprietary repair materials shall conform to 03 62 00 Non-Shrink Grouting

B. STORAGE:

1. Concrete repair components shall be stored as recommended by the manufacturer, at a minimum, store in a dry covered location, protected from moisture and contamination, and maintained at a temperature between 40°F and 90°F.
2. All compounds used for concrete repair shall be used within the recommended shelf life and discarded thereafter.

1.06 PROJECT CONDITIONS

A. Contractor's site review:

1. After mobilization on site and review of necessary repairs, Contractor shall prepare and submit formal Catalogue of Concrete Repairs to include procedures outlining repair plans for each instance of repair necessary. This submittal shall indicate the location of the repair on the existing structure and the category of repair proposed. A running total of proposed repairs shall be included, to correspond to the units of measure in the proposal (if any). The Engineer shall review and may re-categorize repairs. Engineer may also strike repairs if necessary to manage the concrete repair budget.
2. Contractor may propose procedures that differ from this specification. Engineer will review and may accept such differing procedures on a case-by-case basis.

PART 2 - PRODUCTS

2.01 MINOR SPALL REPAIR PRODUCTS

A. Neat Epoxy

1. Required where pedestrian or vehicular traffic is expected.
2. Type VIII epoxy (no sand)

B. Type VIII Epoxy Grout or Mortar. Provide sand aggregate per 03 62 00 Non-Shrink Grouting

1. Master Builders Solutions
2. Five Star Products
3. Euclid Chemical Company
4. Or approved equal

2.02 INTERMEDIATE SPALL REPAIR PRODUCTS

- A. Bagged, dry, proprietary cementitious concrete repair material, conforming to 03 62 00 Non-Shrink Grouting.
- B. Vertical or Overhead Repair:
 - 1. Trowel-applied repair material applied in lifts no greater than 2" thickness.
 - 2. Pneumatically applied cementitious material.
 - 3. Repair material must be non-shrinking per requirements of 03 62 00 Non-Shrink Grouting
- C. Major Spall:
 - 1. Batched concrete, per 03 30 00 Cast In Place Concrete.
 - 2. Bagged, dry, proprietary cementitious concrete repair material.
 - 3. Additional Anchoring
- D. Crack Repair
 - 1. Two component system combined automatically during application.
 - 2. Low viscosity epoxy resin (ASTM C 881 Type IV, Grade 1).

2.03 MIXING

- A. Contractor shall take care to mix all components of all non-premixed products according to manufacturer's instructions. Each component of the mix shall be measured appropriately and added to every batch in amounts that may be applied within the timeframe specified by the manufacturer.
- B. Any components mixed by hand must be per the manufacturer's instructions. All components that are required to be mixed mechanically may not be mixed by hand.
- C. A volumetric mixer must be employed for larger quantities of cementitious repair materials.
- D. Mix Cementitious, Epoxy or Proprietary Grout per 03 62 00 Non-Shrink Grouting.
- E. Curing must be per manufacturer's instructions. Wet curing is the preferred method.
 - 1. If wet curing is disallowed by the product literature, a chemical cure or curing membrane must be used.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Preparation Minor Spalls:
 - 1. Remove laitance, oil, grease
 - 2. Clean and dry areas with oil-free compressed air to be repaired with neat epoxy

3. Remove concrete at edges to at least 10 mils for applications of neat epoxy
4. For areas to receive epoxy mortar, apply neat epoxy compound to substrate as a bond layer

B. Surface Preparation Intermediate Spall:

1. Remove laitance, oil, grease
2. Clean areas to be repaired with oil-free compressed air, saturate substrate with water to surface dry. Surface should remain damp until the repair material is applied
3. Saw cut repair perimeter to eliminate feathered edges to ½" depth at 30 degrees (where possible).
4. Install stainless steel mechanical anchors or pins in Intermediate repair areas >3" in depth where rebar is not exposed. Install at 6" centers, each way. Drill and apply adhesive to anchor pin or dowel holes. Install anchors with a minimum clearance of 1".

C. Surface Preparation Major Spall:

1. Remove laitance, oil, grease or loose or damaged concrete
2. Clean areas to be repaired with oil-free compressed air, saturate substrate with water to surface dry. Surface should remain damp until the repair material is applied
3. Use hand tools or 15 lb class (or less) power driven chipping hammers. If reinforcing bar(s) are exposed, remove concrete from around entire bar, providing ¾" minimum clearance between steel and surrounding concrete.
4. Roughen substrate to a profile of 1/8" or to Concrete Surface Repair Profile 6 per ICRI
5. Saw cut repair perimeter to square to ½" depth at 30 degrees (where possible).
6. Install stainless steel mechanical anchors or pins in Intermediate repair areas >3" in depth where rebar is not exposed. Install at 6" centers, each way. Drill and apply adhesive to anchor pin or dowel holes. Install anchors with a minimum clearance of 1".

D. Surface Preparation for Crack repair:

1. Drill holes to permit installation of the injection ports or mount the ports on the surface as required by the manufacturer. Space ports as per manufacturer's instructions.
2. Clean the interior of crack using care not to force dust and debris further into crack. Clean vertical cracks from top to bottom using oil-free compressed air

3.02 INSTALLATION

A. Minor Spall Repairs – Neat Epoxy

1. For neat epoxy application, brush, roll or scrub the material into the prepared substrate to ensure that all small voids are filled. Cover entire damaged area with a minimum of 10 mils of epoxy material.

B. Minor Spall Repairs –Epoxy Mortar

1. Apply a layer of neat epoxy compound to the substrate, filling all voids to provide a bonding layer.
2. Before bonding layer has lost tack, trowel apply epoxy mortar into the repair area. If bonding coat is no longer tacky, remove and reapply neat epoxy.
3. Limit repair depth to 1". Allow first lift to cure before applying second layer. Apply a bonding layer of neat epoxy to cured epoxy grout before filling minor spall to surrounding concrete level.

C. Intermediate Spall Repairs:

1. Maintain substrate and repair material to a temperature between 40°F and 90°F. Shade from direct sunlight as needed.
2. Apply a scrub coat of repair material with a stiff brush onto damp substrate, filling voids. Do not add excess water from wet brush.
3. Apply initial lift of repair material while bonding layer is still wet or tacky. Lifts shall be 1 ½" or less in thickness. For multiple lifts, roughen preceding lift prior to initial set
4. Apply subsequent lifts after initial set, and wet previous lift just before application.

D. Major Spall Repairs:

1. Maintain substrate and repair material to a temperature between 40°F and 90°F. Shade from direct sunlight as needed.
2. Apply a scrub coat of repair material with a stiff brush onto damp substrate, filling voids. Do not add excess water from wet brush.
3. Apply initial lift of repair material while bonding layer is still wet or tacky. Lifts shall be 1 ½" or less in thickness. For multiple lifts, roughen preceding lift prior to initial set
4. For spalls of large volume, forms may be used and repair material gravity applied.
5. If applied in lifts, apply subsequent lifts after initial set, and wet previous lift just before application.

E. Crack Repairs:

1. Install injection ports first
2. Seal surface of crack between ports using a sealer provided by the epoxy resin manufacturer. Allow sufficient time for sealer to cure before proceeding.
3. Pressure inject epoxy resin into the crack through the ports starting at the lowest point of vertical cracks. Injection mechanisms must use positive displacement pumping action. Equipment must be approved for use with epoxy resin product. Maintain adequate pressure until resin emerges from adjacent port(s).
4. If resin emerges from non-adjacent ports, plug the non-adjacent port until resin emerges from adjacent port.

5. Once resin appears in adjacent port(s), remove injection nozzle, seal the port and begin injecting in the adjacent port.
6. After all ports have been injected, remove the injection ports and surface sealer after the epoxy resin has been given sufficient time to cure. Resin material should not flow from the crack after injection.

3.03 CURING

A. Neat Epoxy:

1. Allow to strengthen per manufacturer's recommendations prior to grinding.

B. Epoxy Grout:

1. Cure per manufacturer's requirements, at least 72 hours.
2. Protect from moisture until fully cured

C. Other cementitious repair materials:

1. Cure per manufacturer's requirements, at least 72 hours.
2. Provide water cure, if possible, covering with wet mat material, rewetting periodically.
3. If water cure is not possible provide curing membrane and curing compound compatible with repair material
4. Maintain temperatures of at least 50° F for curing period

3.04 FINISHING

A. Minor Spalls:

1. Grind neat epoxy to a smooth surface after curing.
2. Smooth repair material to a uniform surface with surrounding concrete.

B. Intermediate Spalls:

1. Begin curing immediately
2. Ensure repairs closely resemble the surrounding concrete.
3. Blend in repaired area with slurry coat finish to blend the repair with surrounding concrete.

C. Major Spalls:

1. Begin curing immediately
2. Ensure repairs closely resemble the surrounding concrete.
3. Blend in repaired area with slurry coat finish to blend the repair with surrounding concrete.

D. Cracks:

1. Grind away any epoxy resin or surface sealer residue on the concrete surface after the injected material has had time to cure.

3.05 FIELD QUALITY CONTROL

- A. Contractor shall confirm that repair performance is acceptable through visual observation of repaired locations. Repair material should not exhibit cracking.
- B. Where applicable, a non-destructive test by firm (but not destructive) blows with a hammer. Breakage, delamination or hollow sounds when the material is struck shall constitute a defective test. Engineer or Inspector shall be present at non-destructive tests.
- C. Repairs deemed defective must be removed and replaced by the Contractor at no additional expense to the Owner.
- D. Prior to and during placement, the Contractor shall verify proper preparation, monitor mixing procedures, observe placement techniques, and document ambient conditions

3.06 PROTECTION

- A. Newly placed repair material shall be protected from excessive heat or cold, vibration and impact, premature loading, excessive water, and contamination.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide design and furnish all material, labor, equipment, and incidentals for fabricating, erecting, supporting, and removing concrete formwork, falsework, shoring for cast-in-place concrete.
- B. Form systems shall be designed in accordance with the requirements of ACI 347 and the Contract Documents.
- C. Section Includes:
 - 1. Formwork for cast-in-place concrete
 - 2. Shoring, bracing, and anchoring
 - 3. Form accessories
 - 4. Form stripping

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 03 15 00 – Concrete Joints and Accessories
 - 2. Section 03 20 00 - Concrete Reinforcing
 - 3. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 117 – Specifications and Tolerances for Concrete Construction and Materials and Commentary.
 - 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. National Sanitation Foundation (NSF)
 - 1. NSF 61 – Drinking Water System Components – Health Effects.

1.04 DESIGN REQUIREMENTS

- A. Formwork shall be designed in conformance with the requirements of ACI 347. Design shall be for all anticipated loads, concrete depth, lateral pressure, and rate of placement.
- B. Metal forms and other similar types of manufactured forms will be allowed only when approved by the Project Engineer. For such forming systems, the contractor shall provide layout, calculations, and other details prepared by a Professional Engineer

1.05 SUBMITTALS

- A. Product Data:
 - 1. Form systems, materials and accessories
 - 2. Form release agent including manufactures installation instructions
 - a. Provide ANSI/NSF 61 certification for form release agents to be used in potable water containing structures
 - 3. Form ties including method for sealing holes
- B. Shop Drawings:
 - 1. Show formwork construction, including joints, reveals, locations of ties, and accessories
 - 2. Indicate proposed construction joints including those not shown on the contract drawings.
 - 3. Indicate dimension and design loadings
 - 4. Provide shop drawings and design calculation from a professional engineer for:
 - a. Metal forms or other similar systems.
 - b. Falsework and shoring for elevated concrete slabs, walkways, and other similar.
 - 5. The requirement for shop drawings of form work may be waived by the Engineer if requested in writing by the Contractor.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications:
 - 1. Professional Engineer licensed in the project jurisdiction
 - 2. Minimum 5-years experience in formwork design
- B. Comply with requirements of ACI 347 and ACI 301

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store materials off ground in ventilated and protected area.
- B. Protect form materials from moisture, sunlight, and damage

- C. Handle materials to prevent damage

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Concrete:

1. Plywood: B-B High Density Overlay, Class I
2. Steel (With prior approval from the Engineer): Minimum 16-gauge sheet steel, flat surface
3. Other (With prior approval from the Engineer): Material capable of producing smooth, uniform surfaces

B. Forms for Unexposed Concrete:

1. Plywood: DOC PS 1, B-B grade
2. Lumber: Standard grade, dressed on 2 edges
3. Steel (With prior approval from the Engineer): Minimum 16 gauge sheet steel

2.02 FORMWORK ACCESSORIES

A. Form Ties

1. Cone nut threaded rod or standard snap-tie type that are factory-fabricated, removable with a Minimum working strength of 3,000 pounds.
 - a. Leave no metal closer than 1-1/2 inches to surface
 - b. Cone diameter no larger than 1 inch
 - c. Water stop ties for water holding structures, basements, and other below grade structures shall be furnished with neoprene water stop 3/16-inch thick and 15/16-inch diameter whose center hole is one-half diameter of tie or a molded plastic water stop of comparable size.
2. Alternate form ties to those specified in Section A above will require prior approval from the Engineer.

B. Form Release Agent:

1. Colorless mineral oil that will not stain concrete, Non-toxic, VOC compliant, and compatible with subsequent surface treatments.
 - a. NSF-61 certification required for form release agents used in potable water containing structures.

C. Corner Chamfer Strips:

1. 3/4 -inch by 3/4 inch wood, PVC, or rubber provided at the maximum length possible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, elevations, and measurements before proceeding
- B. Verify foundation conditions are ready for formwork
- C. Monitor formwork for movement during concrete pour.

3.02 INSTALLATION

- A. Construct forms according to ACI 347. A. Forms shall be built to conform to the shape, lines and dimensions of the concrete work. Forms shall be set to line and grade and shall be braced, tied and secured in a manner which will withstand placing of the concrete and which will maintain shape and position. Forms shall be tight and be substantially assembled to prevent bulging and the leaking of concrete.
 - 1. Aligned to produce specified tolerances as noted in following sections
 - 2. Joints shall be arranged vertically or horizontally
 - 3. Install chamfer strips at external horizontal and vertical corners
 - 4. Provide for openings, offsets, keyways, recesses, bulkheads, and other similar features as required.
- B. Install and support wall spools, sleeves, and other embedded items. Do not weld, tie, or otherwise connect embedded items to reinforcing steel.
 - 1. Pipes, sleeves, or other castings located below grade or operating water level shall have water stop collars and shall be cast in place. Block out and grouting of such items after concrete section is cast is not permitted unless prior authorization is received from the Engineer.
- C. Provide temporary openings, where required, at the bottoms of wall forms and elsewhere to facilitate cleaning and inspecting.
- D. Shoring and Falsework:
 - 1. Shores and falsework shall be used where necessary. If adequate foundations for shores cannot be obtained, trussed supports shall be provided. Structural members, and other work which will be subject to additional loads during construction, shall be adequately shored to protect that work from distortion and damage.
- E. Apply form release agent prior to placement of reinforcing steel
- F. Clean forms of debris and foreign material before concrete placement

3.03 TOLERANCES

- A. Variation from Plumb:
 - 1. Lines and surfaces of columns and walls: 1/4 inch per 10 feet

2. Maximum for entire height: 1 inch
 - B. Variation from Level:
 1. Slab soffits, ceilings, beam soffits: 1/4 inch in 10 feet
 2. Maximum for entire length: 3/4 inch
 - C. Formed Surface Irregularities
 1. Construct forming to provide completed surfaces complying with tolerances specified in AC 117, ACI 301, and ACI 347
 - a. Architectural finish forming, or where otherwise indicated on the drawings, shall be Class A surface, 1/8" offset.
 - b. Other surfaces exposed to view shall be Class B surface, 1/4" offset
 - c. Surfaces not exposed to view shall be Class C surface, 1/2" offset
 2. Tolerances apply to form offsets and to irregularities within the formed surface when measured with a straight edge over a 5' distance.
- 3.04 FORM REMOVAL
- A. Remove forms in accordance with ACI 347 recommendations
 - B. Remove forms without damaging concrete
 - C. Repair any damaged areas immediately
 - D. Wood forms shall be completely removed from all portion of the work so that no material will remain for termite infestation.
 - E. Forms shall remain in place until concrete has achieved sufficient strength. The following indicates the minimum time allowed before forms, shoring, and other bracing may be removed. These times are based on air temperatures above 50 degrees Fahrenheit. Removal times may be increased for temperatures below 50 degrees Fahrenheit.
 1. Slabs on grade, walls and vertical faces not supporting other work: 24 hours
 2. Columns, pedestals, and walls supporting other work: Minimum 7 days
 3. Beams, elevated slabs, and other shored forms: Minimum 14 days and 75% design strength
- 3.05 CLEANING
- A. Clean forms to remove concrete residue
 - B. Store forms to prevent damage
 - C. Dispose of damaged or worn out forms

END OF SECTION

SECTION 03 15 00

CONCRETE JOINTS AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all material, labor, equipment, and incidentals for installation of accessories required for concrete construction.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 03 10 00 – Concrete Forming
 - 2. Section 03 20 00 - Concrete Reinforcing
 - 3. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 301 - Specifications for Structural Concrete
 - 2. ACI 318 - Building Code Requirements for Structural Concrete
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler
- C. National Sanitation Foundation (NSF)
 - 1. NSF 61 – Drinking Water System Components – Health Effects.
- D. U.S. Army Corps of Engineers.
 - 1. CRD-C572 - Polyvinyl Chloride Waterstop

1.04 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's data and application instructions for specified materials.
 - a. Provide samples when requested by the Engineer
 - b. Provide NSF 61 certification for materials used on potable water containing structures.

B. Shop Drawings:

1. Submit layout of and location of all proposed joints not shown on the contract drawings.
2. Indicate proposed construction joints not shown on the contract drawings.

1.05 QUALITY ASSURANCE

- A. Comply with applicable sections of 01 40 00
- B. Do not add, omit, or relocate joints without approval from the Engineer.
- C. Clean and prepare surfaces as required by the material manufacturer.
- D. Protect waterstop from damage during construction

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store materials as recommended by the manufacturer.
- B. Handle materials to prevent damage

PART 2 - PRODUCTS

2.01 WATERSTOPS

A. PVC (Polyvinyl Chloride) Waterstop

1. Extruded from elastomeric PVC compound and meeting the requirements for US Corp of Engineers CRD – C572.
2. Provide ribbed, ribbed with center bulb, dumbbell, or retrofit system for the locations indicated on the drawings and of the size and type indicated in the structural details.
3. Performance Requirements:
 - a. Water absorption: 0.15%
 - b. Tear resistance: 300 lb/in
 - c. Tensile strength: 2,000 psi (min.)
 - d. Ultimate elongation: 350% min.
4. Manufacturers: Greenstreak, BoMetals, or equal

B. Strip Applied Waterstop Non-swelling gasket (mastic) waterstop

1. Physical Properties
 - a. Specific gravity: 1.15 + 1.50
 - b. Flash point: 350° F min.

- c. Fire point: 375° F min.
- d. Ash inert materials: 25% min.
- e. Volatile material: 3% min.
- 2. Accessories: Provide with manufacturer's recommended prior for location and conditions.
- 3. Manufacturers: Sika Lockstop or equal

C. Strip Applied Hydrophilic Rubber Waterstop

- 1. Manufactured from a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.
- 2. Waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete
- 3. Performance requirements:
 - a. Chloropene Rubber
 - 1) Tensile Strength: 1,300 PSI min.
 - 2) Ultimate Elongation: 400% min.
 - 3) Hardness (Shore A): 50 ± 5
 - 4) Tear resistance: 100 lb/in min.
 - b. Modified Chloropene (Hydrophilic) Rubber
 - 1) Tensile Strength: 350 PSI min.
 - 2) Ultimate Elongation: 600% min.
 - 3) Hardness (Shore A): 52 ± 5
 - 4) Tear resistance: 50 lb/in min.
 - 5) Expansion Ration: 3 to 1 min.
- 4. Accessories: Provide manufacturer's recommended adhesive, sealants, and/or primer for location and conditions

2.02 EXPANSION JOINTS

A. Expansion Joint Filler

- 1. Asphalt Impregnated Cellulose Fiber
 - a. Location: Provide at Sidewalks, driveways, and other similar locations.

- b. Material: Resilient, flexible, non-extruding, expansion-contraction joint filler. Cellular fibers securely bonded together, uniformly saturated with asphalt, meeting the requirements of ASTM D1751.
 - c. Resilience: When compressed to half of original thickness, recover to a minimum of 70% of original thickness.
 - 2. Granulated Bonded Cork
 - a. Location: Liquid Holding Structures
 - b. Material: Granulated cork bonded with phenolic resin meeting the requirements of ASTM D1752, Type II.
 - c. Resilience: When compressed to half of original thickness, recover to a minimum of 95% of original thickness
 - 3. Flexible Foam Expansion Joint Filler
 - a. Location: Non-liquid Holding Structures
 - b. Material: Synthetic foam of isomeric polymers in a very small, closed-cell structure meeting the requirement of ASTM D1752, Type II, ASTM D545
 - c. Resilience: When compressed to half of original thickness, recover to a minimum of 99% of original thickness.
 - d. Provide CERAMAR by W.R. Meadows or equal.
- B. Expansion Joint Filler Adhesive:
 - 1. Provide as recommended by the filler manufacturer.
 - 2. NSF-61 approved for potable water treatment or containment structures
- C. Expansion Joint Sealant
 - 1. Location: Provide at all exposed expansion joint surfaces unless noted otherwise.
 - 2. Material: premium-grade, high-performance, moisture-cured, 1-component, polyurethane-based, non-sag elastomeric sealant. Sikaflex or equal.
 - a. NSF-61 approved for water containing structures.
- D. Smooth Dowels
 - 1. Location: Provide in locations or at joint types indicated on the drawings
 - 2. Material: ASTM A36 Steel, unless noted otherwise on the drawings
 - 3. Size: As indicated on the drawings
 - 4. Lubricants (Bond Breaker)

- a. Potable Water Treatment or Storage Structures: Food grade vegetable oil unless otherwise approved by the Engineer
- b. Other Locations: Form release oil unless otherwise approved by the Engineer

2.03 CURING COMPOUND

- A. Clear, non-yellowing, membrane-forming, acrylic curing compound in accordance with ASTM C309, Type 1, Class B as manufactured by WR Meadows, Euclid, or equal.

2.04 FLOOR HARDENER

- A. Water soluble, inorganic, silicate based hardening compound. Sikagard 200 HD WB or equal.

2.05 BONDING AGENT

- A. Bonding New Concrete to Existing Concrete

- 1. Medium viscosity, 1:1 high-strength epoxy bonding agent. Two-component, 100% solids, amine-cured epoxy resin adhesive. Conforms to ASTM C-881 Type II as manufactured by Prime Resins, Master Builders, or equal

- B. Admixture for Concrete Finishing

- 1. Acrylic latex liquid bonding admixture compliant with ASTM C1059, Type II, non-yellowing, UV resistant as manufactured by Euclid, WR Meadows, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. PVC Waterstops

- 1. Provide PVC waterstops in all joints below grade or below the operating level of water containing structures unless noted otherwise on the drawings.
- 2. Field butt splices shall be fused welded using a thermostatically controlled waterstop iron as recommended by the manufacturer. Follow the Manufacturers recommended methods for welding. Lapping, gluing or use of adhesives shall not be permitted.
 - a. Tensile strength of splice shall not be less than 80% of the unspliced material.
- 3. Use manufacturer's fabricated crosses, tees and ells.
- 4. Center waterstop in the joint and secure waterstop in correct position using hog rings, grommets, or eyelets spaced a maximum of 18 inch on center along the length of the PVC waterstop and wire tied to reinforcing steel.
- 5. Position waterstop to ensure proper distance from steel reinforcing bars. Do not allow contact between waterstop and form ties.

- B. Strip Applied Waterstop Non-swelling gasket (mastic) waterstop

1. Provide where indicated for non-moving joints at foundations and other non-liquid containing structures.
2. Apply primer as recommended by the manufacturer.
3. Splice joints by lapping a minimum of 1 inch unless noted otherwise by the manufacturer. Press ends together with molding action until there is no separation or air pockets.

C. Strip Applied Hydrophilic Rubber Waterstop

1. Provide where indicated for construction joints in liquid holding structures where PVC waterstop is not practical.
2. Apply primer and/or adhesive recommended by the manufacturer.
3. Adhere and seal splices as recommended by the manufacturer.

D. Expansion Joints

1. Expansion Joint Fillers and Sealant

- a. Install in locations noted on the drawings.
- b. Provide type appropriate to the locations as specified herein or indicated on the drawings
- c. Apply with adhesive or anchoring system as recommended by the manufacturer.
- d. Apply sealant at all exposed surfaces unless noted otherwise on the drawings.

2. Smooth Dowels

- a. Install at locations or joint types indicated on the drawings
- b. If trimming is required, dowels shall be saw cut, not sheared
- c. Dowels shall be clean and free of rust, dirt, corrosion, or mill scale
- d. Apply appropriate lubricant/bond breaker for the installation location.
- e. Install dowels parallel to the surface and square to the joint face.

3.02 CURING COMPOUND

- A. Refer to Section 03 30 00 for concrete curing requirements.

3.03 FLOOR HARDENER

- A. Apply to all interior or under shelters slabs that are not scheduled to receive floor coverings.

3.04 BONDING AGENTS

- A. Apply per manufacturer's instructions

3.05 CONSTRUCTION JOINTS:

- A. Contractor shall provide construction joints where necessary whether shown on the construction drawings or not.
- B. Construction joints not shown on the contract drawings, but necessary for the Contractor's proposed construction sequence or methods, must receive prior approval from the Engineer.
- C. All construction joints must be clearly shown on the shop drawings as per Section 1.04.B.
- D. Contractor shall provide all bulkheads, keyways, waterstops, and other accessories as necessary for joint construction.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.01 SUMMARY

A. DESCRIPTION

1. The work covered by this section of Specifications consists of furnishing all materials and equipment and performing all labor necessary for furnishing and installing all reinforcing steel and appurtenances as indicated on the Drawings, as specified, and as required for completion of all work under this contract.

B. SECTION INCLUDES:

1. Reinforcing steel bars, welded wire fabric, bar supports, and accessories
2. Shop fabricated reinforcing
3. Field fabricated reinforcing
4. Reinforcement for both structural (ACI 318) and environmental (ACI 350) applications

1.02 RELATED DOCUMENTS

- ###### **A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.**

B. Related Specifications

1. Section 03 10 00 - Concrete Forming
2. Section 03 15 00 – Concrete Joints and Accessories
3. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCES

A. American Concrete Institute (ACI):

1. Building Code Requirements for Structural Concrete
2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures
3. ACI 117 - Specifications for Tolerances for Concrete Construction
4. ACI 315 - Details and Detailing of Concrete Reinforcement
5. SP-66 - ACI Detailing Manual

B. ASTM International:

B. ASTM International:

1. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars
2. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed Bars
3. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement
4. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars
5. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars

C. CONCRETE REINFORCING STEEL INSTITUTE (CRSI):

1. Manual of Standard Practice
2. Placing Reinforcing Bars

1.04 ENVIRONMENTAL REQUIREMENTS

A. For structures designed to ACI 350:

1. Maximum crack width: 0.010 inches
2. Increased concrete cover requirements
3. Additional seismic requirements per Chapter 21
4. Enhanced durability requirements

1.05 SUBMITTALS

1. Shop Drawings:

- a. Drawings detailing the bar size, spacing, location and quantities for placement of concrete reinforcing.
- b. Shop drawings shall be prepared in accordance with ACI 315
- c. Provide bending and cutting schedules
- d. Show details for all supporting and spacing devices
- e. Show location and details of lap splices and bar clearances.
- f. Provide details for reinforcement through proposed construction joints not shown on the contract drawings. Refer to Section 03 10 00, Concrete Joints and Accessories, for required approvals prior to rebar detailing.
- g. Clearly indicate structures governed by ACI 350

B. Product Data:

1. Mill certificates for each heat of reinforcing steel

2. Mechanical splice device data
 3. Welded wire fabric specifications
 4. Bar support specifications
- C. Quality Control Submittals:
1. Welding certificates if required
 2. Manufacturer's instructions for coated reinforcing
- 1.06 QUALITY ASSURANCE
- A. Welders Qualifications:
1. AWS D1.4 qualified
 2. Current certification within previous 12 months
- B. Testing Laboratory:
1. Independent testing laboratory
 2. Minimum 5 years experience in reinforcing steel testing
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Storage:
1. Store reinforcing above ground on platforms or skids
 2. Protect from dirt, grease, and rust
 3. Maintain identification tags and marks
 4. Protect epoxy and galvanized coatings from damage

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcing Steel:
1. Bar reinforcement shall be furnished by domestic steel mills.
 2. Bar reinforcement shall be deformed bars and conform to the requirements of ASTM A- 615 Grade 60
 3. The steel for bars shall be made by the open hearth, basic oxygen or electric furnace process, and the bars shall be rolled from billets or ingots of properly identified heats. The steel shall be made and the bars rolled in the United States. The use of cold twisted bars will not be permitted

4. ASTM A706, Grade 60, for welded reinforcing
5. For environmental structures (ACI 350):
 - a. Use ASTM A706 for all welded reinforcing
 - b. Epoxy coated per ASTM A775 where specified

B. Welded Wire Fabric:

1. Wire mesh reinforcement shall conform to the requirements of ASTM A-1064
2. Unless otherwise indicated in the Drawings, provide be 4-inch by 4-inch mesh of 6-gauge wire.
3. Provide flat sheets only, no rolls permitted

C. Coated Reinforcing:

1. Epoxy Coating: ASTM A775
2. Galvanizing: ASTM A767, Class I coating

D. Fiber Reinforcement

1. Location: Provide where noted on the drawings
2. Materials: Maxten, Fibermesh 650 or approved equal
3. Rate: Applied at 5 lb/cy (unless noted otherwise), mixed and uniformly distributed in concrete

2.02 ACCESSORIES

A. TIE WIRE:

1. Minimum 16 gauge annealed wire
2. For epoxy-coated bars provide plastic coated or stainless-steel wire.

2.03 BAR SUPPORTS SHALL BE PROVIDED AS FOLLOWS:

- A. CRSI Class 1 for exposed concrete
- B. CRSI Class 2 for unexposed concrete
- C. Stainless steel or plastic tipped where exposed
- D. Alternately for slabs on grade: Precast concrete blocks with embedded wire or concrete bricks having the same minimum compressive strength as the required concrete

2.04 FABRICATION

A. FABRICATE IN ACCORDANCE WITH:

1. Fabrication and bending details for steel bar reinforcement shall conform to the requirements of the ACI 318/350 unless otherwise indicated on the Drawings or specified.
 - a. Minimum bend diameters shall be in accordance with ACI 318/350
2. For environmental structures, fabricate in accordance with ACI 350
3. Fabricate in accordance with CRSI Manual of Standard Practice
4. Fabricate in accordance with approved shop drawings.
5. Steel bar reinforcement shall be cold bent to shapes indicated on the Drawings. Bending shall be done in the shop before shipment unless otherwise specified. No field bending of bars partially embedded in concrete.
6. Hooks of 180° shall have a radius of bend on the axis of the bar of not less than three (3) bar diameters plus an extension of four (4) bar diameters at the free end. Hooks of 90° shall have a radius of bend on the axis of the bar of not less than four (4) bar diameters plus an extension of twelve (12) bar diameters at the free end
7. Steel bar reinforcement shall be bent, bundled and tagged in accordance with details furnished by the fabricator

PART 3 - EXECUTION

3.01 PLACEMENT

A. GENERAL REQUIREMENTS:

1. Place reinforcing steel and welded wire fabric in accordance with approved shop drawings
2. Maintain minimum concrete cover per ACI 318/350
3. Secure against displacement during concrete placement using bolsters, chairs, or other devices to prevent sinking into earth or being displaced during concrete placement.
4. Reinforcement must be clean and free of loose rust, scale, and contaminants

B. ENVIRONMENTAL STRUCTURES (ACI 350):

1. For environmental structures, increase cover requirements as follows:
 - a. Walls and slabs: 2 inches minimum
 - b. Beams and columns: 2.5 inches minimum

3.02 SPLICING

A. LAP SPLICES:

1. Steel bar reinforcement shall be furnished full length unless otherwise indicated on the Drawings.

2. Splices, where permitted, shall be well distributed or located at points of low tensile stress.
3. Lap splices shall be in accordance with ACI 318/350 requirements
4. Splices and dowels, except when used in cantilever wall or slab construction, shall lap not less than thirty (30) times the diameter of the bar. Splices and dowels used in cantilever wall or slab construction shall lap forty (40) diameters
5. Stagger splices in adjacent bars
6. Provide increased lap lengths for environmental structures
7. The minimum clear distance between spliced bars, except when bar clamps are specified, shall be 1-½ bar diameters, but in no case less than 1-inch, nor less than 1-½ times the maximum size of coarse aggregate.
8. Design is based upon “non-contact” type vertical splices lapped and specified above as required under the applicable sections of the ACI code. Tied “contact” lapped splices will be allowed for ease in establishing the basic framework for the vertical rebar mats. However, no more than 20% of the required vertical lap splices may be “contact” type splices. All other lap splices shall conform to the minimum and maximum clear distance requirements as specified above and in the applicable sections of the ACI code.

B. MECHANICAL SPLICES:

1. Mechanical splices, when noted on the drawings or approved by the Engineer, shall be installed per manufacturer's instructions.
2. Stagger splices in adjacent bars
3. Provided tension testing of 1 in 10 splices

3.03 REINFORCEMENT AROUND OPENINGS AND PENETRATIONS

- A. Openings 12-inches and larger through concrete walls and slabs shall have a minimum of eight (8) extra diagonal bars in each face of the wall or slab of the same size as the largest bar in the wall or slab. The length of extra diagonal bars at openings shall be as shown on the Drawings or diameter of opening plus 24 bar diameters each end of bar.

3.04 TOLERANCES

A. FABRICATING TOLERANCES:

1. Sheared length: ±1 inch
2. Stirrups and ties: ±1/2 inch
3. Bends: ±1 inch

B. PLACING TOLERANCES:

1. Concrete cover: -0/+1/2 inch
2. Spacing: ±1/4 inch where concrete cover is ≤4 inches

3. Bar position: $\pm 1/2$ inch where concrete cover is >4 inches

3.05 FIELD QUALITY CONTROL

A. SITE INSPECTIONS:

1. Do not place concrete until reinforcing is inspected by the Engineer.
2. Do not close up formwork for walls and other members until reinforcing is inspected by the Engineer.
3. Inspection shall include but is not limited to verification of reinforcing placement, bar grade markings, concrete cover, splices and laps,
4. Observe mechanical splice installation

B. SPECIAL REQUIREMENTS FOR ACI 350 STRUCTURES:

1. Additional inspections for crack control measures
2. Verification of increased cover requirements
3. Testing of mechanical splices per ACI 350

3.06 PROTECTION

A. Protect reinforcing from:

1. Mechanical damage
2. Rust and contaminants
3. Concrete splatter
4. Oil and grease

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. DESCRIPTION:

1. The work described by this Section consists of furnishing all materials and equipment and performing all labor for the complete construction of all concrete work.
2. Concrete shall be composed of cement, Class F fly ash (if required) admixtures (if required), fine aggregate, coarse aggregate and water proportioned and mixed to produce a plastic workable mix in accordance with the requirements of this Section and shall be suitable for the specific conditions of placement. Concrete shall be classified as "A," "B" or "C," shall have normal setting characteristics (unless high early strength cement is specified); shall be used in the locations identified below and shall have 28-day compressive strengths not less than those specified here in, except that concrete containing high early strength cement shall have 7-day compressive strengths not less than those specified.

B. SECTION INCLUDES:

1. Cast-in-place concrete for structural applications (ACI 318)
2. Cast-in-place concrete for environmental structures (ACI 350)
3. Concrete mixtures, placement, finishing, and curing
4. Quality requirements and testing

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 45 16 – Field Quality Control Procedures
2. Section 03 10 00 - Concrete Forming and Accessories
3. Section 03 20 00 - Concrete Reinforcing
4. Section 03 15 00 - Concrete Accessories
5. Section 03 35 00 - Concrete Finishing

1.03 REFERENCES

A. AMERICAN CONCRETE INSTITUTE:

1. ACI 318 - Building Code Requirements for Structural Concrete
2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures
3. ACI 301 - Specifications for Structural Concrete
4. ACI 117 - Tolerances for Concrete Construction
5. ACI 305R - Guide to Hot Weather Concreting
6. ACI 306R - Guide to Cold Weather Concreting
7. ACI 308R - Guide to External Curing of Concrete

B. ASTM INTERNATIONAL:

1. ASTM C31 - Making and Curing Concrete Test Specimens
2. ASTM C33 - Concrete Aggregates
3. ASTM C39 - Compressive Strength of Concrete Specimens
4. ASTM C94 - Ready-Mixed Concrete
5. ASTM C150 - Portland Cement
6. ASTM C171 - Sheet Materials for Curing Concrete
7. ASTM C309 - Liquid Membrane-Forming Compounds for Curing
8. ASTM C494 - Chemical Admixtures for Concrete
9. ASTM C618 - Coal Fly Ash for Use in Concrete

1.04 SUBMITTALS

A. Mix Designs:

1. Submit for each concrete classification including:
 - a. The design mix shall be prepared, proportioned and mixed using samples of the cement, fly ash (if required), admixture (if required) and the aggregates to be used in the work.
 - b. For each concrete classification mix design, provide a minimum of 4 cylinders prepared and tested by a certified laboratory. 2 shall be tested at 7 days, and 2 shall be tested at 28 days. Cylinders shall be made and tested in accordance with ASTM C-31 and C-39.
 - 1) Alternately, submit test results of 7- and 28-day compressive strength test where the same mix has been used on two previous projects in the past twelve months.
2. Product Data and Certifications

- a. Cement mill tests and certification for compliance with ASTM C150 and these specifications.
- b. Gradation analysis on fine and coarse aggregate and
- c. Admixture product data and certifications
- d. Test records demonstrating compliance
- e. Environmental exposure classification

B. Shop Drawings:

- 1. Construction joint locations
- 2. Placement sequence and schedule

C. Quality Control Program:

- 1. Cooperate with Owner's Testing Agency, submit contact information.
- 2. Cold and hot weather procedures
- 3. Curing methods
- 4. Inspection requirements
- 5. Record keeping and documentation procedures.
- 6. Corrective action requirements

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

- 1. NRMCA certified plant
- 2. Minimum 5 years experience

B. Testing Agency:

- 1. Testing to be Provided by the Owner

1.06 ENVIRONMENTAL STRUCTURES

- A. Environmental Structures shall be those which hold process water or sewage for water or wastewater treatment as defined in ACI 350. These structures have increased durability requirements, enhanced water tightness criteria and higher chemical resistance.
- B. All concrete for environmental structures shall be class A-2, unless otherwise noted.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Cement:

1. ASTM C150, Type II for general use. Type I may be used in lieu of Type II with approval from the Engineer.
2. Type III, High Early Strength, may be approved by the Engineer on a case-by-case basis.

B. Fly Ash

1. Class F conforming to ASTM C-618
2. Loss of ignition shall not be more than 6%
3. Shall not exceed 25% of the total cementitious material.
4. Fly ash in concrete for potable water structures shall be certified as meeting NSF 61.

C. Aggregates:

1. Fine Aggregate:

- a. Fine aggregate shall be clean, sharp, natural sand having a having fineness modulus of no less than 2.30 and no more than 3.00. Variation in fineness modulus shall be limited to +0.20 from the average of all tests.
- b. Aggregate shall satisfy the requirements of ASTM C-33, amended to date, except that gradation shall be as follows:

Sieve Size	Percent Passing, by Weight
No. 4, Sieve	95 – 100
No. 8, Sieve	80 - 90
No. 16, Sieve	50 - 85
No. 30, Sieve	25 - 60
No. 50, Sieve	10 - 30
No. 100, Sieve	2 – 10

2. Coarse Aggregate:

- a. Coarse aggregate shall be washed gravel or crushed stone consisting of hard, strong, durable and uncoated particles and shall contain neither vegetable matter nor soft, friable, thin and elongated particles in quantities considered deleterious by the Engineer.
- b. Coarse aggregates shall satisfy the requirements of ASTM C-33, as amended to date, except that gradations shall be as follows:

Sieve Size	Percent Passing, by Weight
1-½" Sieve	100
1" Sieve	95 – 100
½" Sieve	25 - 60
No. 4, Sieve	0 - 10
No. 16, Sieve	0 - 5

D. Water:

1. Clean and potable
2. Maximum chloride ion content for environmental structures: 500 ppm

2.02 ADMIXTURES

A. Provide admixtures in accordance with the manufacturer's instructions. Do not use admixtures that have not been incorporated and tested with the approved mixes unless approved by the Engineer.

B. Air Entraining:

1. ASTM C260
2. Required for environmental exposure

C. Water Reducing:

1. ASTM C494, Type A
2. Certified compatible with other admixtures

D. Retarding:

1. ASTM C494, Type B
2. Certified compatible with other admixtures

E. Crystalline Waterproofing (for ACI 350 structures):

1. Permanent, integral crystalline admixture, Xypex, Penetron, or approved equal.
2. Minimum dosage per manufacturer

2.03 CONCRETE MIXTURES

A. Class A-1 - Structural Concrete (ACI 318):

1. To be used for slabs and walls of all non-environmental structures.
2. Minimum compressive strength: 4,000 psi at 28 days
3. Minimum cementitious material: 564 pounds

4. Maximum w/c ratio: 0.45
5. Air content: : 5% $\pm$ 1% (Lower air content may be allowed for architectural slabs with prior approval from the Engineer)
6. Slump: 4 inches $\pm$ 1 inch (6-9" $\pm$ 1.5" with H.R.W.R.)
7. Provide fiber reinforced Class A-1 mixtures where indicated on drawings.

B. Class A-2 - Environmental Structures (ACI 350):

1. To be used for slabs and walls of all water containing structures.
2. Minimum compressive strength: 4,500 psi at 28 days
3. Minimum cementitious material: 600 pounds per cubic yard
4. Maximum w/c ratio: 0.40
5. Air content: 5% $\pm$ 1%
6. Slump: 4 inches $\pm$ 1 inch (6-9" $\pm$ 1.5" with H.R.W.R.)
7. Crystalline waterproofing admixture
8. Maximum chloride ion content: 0.15% by weight of cement

C. Class B

1. To be used for blocking, sidewalks, or where otherwise approved by the Engineer
2. Minimum compressive strength: 3,000 psi at 28 days.
3. Minimum cementitious material: 470 pounds per cubic yard
4. Maximum w/c ratio: 0.50
5. Air content: 5% $\pm$ 1%
6. Slump: 4 inches $\pm$ 1 inch
7. Provide fiber reinforced Class B mixtures where indicated on drawings.

D. Class C

1. To be used for mud mats, pipe envelopes, and concrete backfill.
2. Minimum compressive strength: 2,000 psi
3. Minimum cementitious material: 376 pounds per cubic yard

PART 3 - EXECUTION

3.01 PREPARATION

1. Before constructing concrete slabs on earth, all piping which will be under those slabs shall have been tested, approved and encased in Class "C" concrete. The sub-grade shall provide a solid bearing and shall be brought to a true and even plane. Where floor drains occur, floors shall be pitched thereto as shown on the Drawings.
2. Before concrete is placed, the depth and character of the foundations, the adequacy of forms and falsework and the placing of reinforcing steel and inserts must be inspected and reviewed by the Engineer. The Engineer's review, however, shall not relieve the Contractor from the responsibility to produce the required work.
3. Accumulated water and debris must be removed from excavations and from forms into which concrete is to be placed. Flow of water into those places shall be diverted into side drains or sumps and be removed without disturbing newly placed concrete.
4. Forms, unless lined, shall be thoroughly wetted with water before concrete is placed so as to tighten the joint. Runways for buggies and wheelbarrows, if used, shall not be supported by forms.

3.02 NOTIFICATION

1. Contractor shall notify the testing laboratory 24 hours before placement of concrete.
2. Contractor shall notify Engineer 48 hours before placement

3.03 CONCRETE MIXING

A. Central Mix Plant.

1. Concrete shall be mixed (and transported to the jobsite) in accordance with the requirements of ASTM C-94
2. Proportioning and mixing shall be accomplished at a central mix plant. The mixing facility shall be made available to the Engineer or Owner's Testing Agency to observe quality control procedures.
3. Proportioning of materials shall be accomplished in a manner which will produce a workable mixture having a slump within the required limits and having minimum water content.
4. The exact proportion of materials to be used in concrete shall be identical to that established by the design mix. The equipment necessary to positively determine and control the amounts of materials entering the concrete shall be furnished by the Contractor.
5. Loading tickets for Class "A-1" or Class "A-2" concrete shall be provided to the Testing Agency representative or Engineer's inspector upon arrival to the job site and shall bear the time of loading.
6. Transport and place concrete not more than 90 minutes after water has been added,

B. Site Mixing:

1. Site Mixing of concrete, if approved by the Engineer, shall be accomplished with a batch mixer of approved design and of a type which will insure a uniform distribution of the ingredients. The entire contents of the drum shall be discharged before recharging. The

volume of each batch shall not exceed the rated capacity of the mixer. The Contractor shall, during the mixing and placing of concrete, have no fewer than 2 mixers on the job site to maintain continuity of the placing in the event of mechanical failure of 1 of the mixers. The mixing of each batch shall continue not less than 1-½ minutes after all ingredients have been placed in the mixer. During mixing the mixer shall rotate at peripheral speed of no fewer than 200' per minute.

2. Contractor shall provide the equipment necessary to positively determine and control the actual amounts of ingredients entering the mix.

3.04 PLACING CONCRETE

A. General Requirements:

1. Concrete shall be placed per ACI 301 and ACI 304 procedures.
2. Concrete shall be placed in daylight. Placing of concrete in a portion of the work shall not be started if that portion of the work cannot be completed during daylight unless otherwise specifically approved by the Engineer. That approval, however, will not be given unless an adequate lighting system is provided and lighting system is approved by the Engineer.
3. Concrete shall be placed in a manner which will prevent the segregation of aggregates, displacing reinforcing and coating and splattering the concrete reinforcing which is in place. Troughs, pipes, hoppers, chutes and canvas tremies shall be arranged and used in a manner which will ensure the concrete is placed in the manner specified. If concrete must be dropped more than 5', it shall be deposited through a tremie
4. The placing of concrete within formwork shall be regulated in a manner which will ensure that the pressure within the formwork, caused by that placing shall not exceed the design pressure of the formwork.
5. Concrete shall be placed in continuous horizontal layers, the thickness of which in general, shall not exceed 12". Each batch and each layer shall be placed immediately following the preceding batch and layer, so there will be no "cold joints" in the work. Care shall be used to fill each part of the forms. Concrete shall be deposited as near final position as possible. After the concrete has taken its initial set, care shall be used to avoid jarring the formwork and placing strain and vibration on the ends of projecting concrete reinforcements.
6. Concrete shall be placed and compacted in a manner which forms a dense, compact, impervious structure having smooth faces on exposed surfaces. Concrete work found to be porous, plastered and otherwise defective in the opinion of the Engineer shall be removed and replaced in whole or in part as directed by the Engineer at no additional expense to the Owner

B. Consolidation:

1. Concrete when placed shall be compacted with mechanical internal-vibrating equipment. Compaction shall be supplemented with hand spading using a steel-splicing rod. Vibrating equipment shall maintain an impulse rate of no less than 5,000 impulses per minute when submerged in concrete. No less than 1 spare vibrator shall be maintained on the job site as a relief.

2. The duration of vibration shall be limited to that time necessary to satisfactorily consolidate the concrete without causing objectionable segregation. The vibrator shall not be inserted into lower layers which have begun to set.
3. Vibrating equipment shall not be used to transport concrete within forms.
4. Thin-section work shall be thoroughly worked with a steel rod. Faces of thin-section work shall be shaped and mortar flushed to the surface. Small diameter holes shall be drilled in formwork beneath large wall sleeves and inserts to prevent the entrapment of air beneath those sleeves and inserts when concrete is placed.

C. Hot and Cold Weather Placement:

1. Concrete shall not be placed when the atmospheric temperature is cooler than 35°F. If, after placing concrete, the atmospheric temperature becomes cooler than 35°F, refer to the Contractor shall enclose, heat and protect the concrete in a manner which will keep the air surrounding the fresh concrete at a temperature not cooler than 45°F for a period of 5 days after concrete is placed. In addition, all requirements specified in ACI 306.1-90 Standard Specification for Cold Weather Concreting shall apply. The Contractor shall assume all risk of protecting the concrete. Unsatisfactory concrete shall be rejected.
2. When the ambient temperature is 90°F or above, special precautions shall be taken during mixing, placing and curing. In no case should the temperature of the concrete, when placed, be above 90°F. Attention shall be given to coordinating the dispatching of trucks with the rate of placement to avoid delays in delivery. On truck arrival at the job site, addition of water shall not be allowed other than that required to adjust the specified slump, provided the specified water to cement ratio is not exceeded. The forms and reinforcing steel should be cooled to a temperature of not more than 90°F by spraying with fog nozzles. Admixtures or retardation shall conform to ASTM C494-15. Water curing is preferred but prompt application of curing compound, ASTM C309-11, may be used. In addition, all requirements specified in ACI 350 5.14 Cold weather requirements and ACI 350 5.15 Hot weather requirements shall apply.
 - a) Ice may be added at the job site provided the water to cement ratio does not exceed the specified percentage (i.e. water held back at plant during mixing). Ice bags with printed weight may be used or bulk iced may be weighed on site before addition.

D. Construction Joints:

1. Construction joints shall be located where shown and where directed and approved by the Engineer. Refer also to Section 03 15 00.
2. Placing of concrete, once started, shall continue without interruption so that the placement will be monolithic. No less than 72 hours shall elapse between casting of adjoining units unless otherwise approved by the Engineer.

E. Bonding:

1. Before placing new concrete work on and against concrete work which has recently set and that which has cured, the surfaces of recently set and cured concrete work shall be thoroughly roughened and made free from all foreign matter and laitance, the forms placed and

tightened, and the surfaces of the recently set and cured concrete slushed with grout. New concrete shall be placed before the grout has attained its initial set. Bonding shall be accomplished in a manner which will insure complete bonding. Grout 2" to 4" shall be applied to construction joints.

2. Bonding of new concrete work to existing hardened concrete shall be accomplished with a bonding agent specified in Section 03 15 00, Concrete Accessories.

F. Environmental Structure Requirements:

1. All joints in hydraulic structures shall include waterstop as indicated in ACI 350 7

3.05 FINISHING

A. General:

1. Exterior concrete surfaces shall be finished to levels no less than 12" below finish grade levels. Interior concrete surfaces below grade and concrete surfaces exposed to view shall be finished. Interior of basins shall be finished to a level not less than 12" below overflow level. All imperfect concrete shall be removed to dense solid concrete and repairs made as directed by the Engineer

B. Formed Surfaces:

1. Remove forms and form ties per Section 03 10 00 when concrete has set sufficiently to allow removal.
2. Repair surface defects. Depressions resulting from removal of form ties and other holes and rough places shall be thoroughly wetted with water and pointed-up

3. Exposed Surfaces:

a. Procedures:

1) Surface Preparation:

- a) Within 72 hours of form removal, grind all seams and form joints level with surrounding concrete. Patch any holes, honeycomb, tie holes, and similar imperfections with non-shrink construction grout, including bonding admixture, and allow to dry. Wall surface must have smooth level finish, approved by the Engineer's inspector, prior to beginning the finish coat

2) Finish Coat:

- a) Apply bonding agent in front of grout application, not allowing to dry before grout is applied. Apply thin coat of non-shrink grout mix with rubber coarse sponge. Follow sponge application with carborundum stone, rubbing grout in a circular motion not allowing the grout to dry. Before grout dries, apply a light broom finish using a soft bristle brush.

b. Products:

- 1) Provide acrylic latex liquid bonding admixture compliant with ASTM C1059, Type II, non-yellowing, UV resistant as manufactured by Euclid, WR Meadows, or equal.
 - 2) Provide non-shrink, non-staining, non-metallic cement based grout compliant with CRD C 621 and ASTM C 1107 as manufactured by Euclid, WR Meadows, or equal.
4. Unexposed Surfaces:
- a. Concrete not exposed to view shall have rough edges tooled off. Irregularities shall be filled, pointed-up with non-shrink sand cement mortar and spot finished

C. Slabs:

1. The concrete shall be screeded level or to the proper grade. After compacting and vibrating the concrete, the surface shall be prepared to receive the specified finish:
2. Float Finish:
 - a. All floors, walks, platforms stairs and other slab work shall have a wood float finish unless noted otherwise. After screeding to the required grade while the concrete is still green but has hardened sufficiently to bear the finisher's weight, the concrete surface shall be floated with a wood float to a true and even plane, have no visible coarse aggregate and be sufficiently rough to prevent slipping.
 - 1) Exterior surfaces, unless noted otherwise, to receive broom finish.
3. Trowel Finish:
 - a. Apply trowel finish on interior slabs to receive floor coverings or where indicated on Drawings. Troweling shall follow the float finish as previously described and when the surface has sufficiently hardened. Trowel until the surface is free of trowel marks and has a uniform appearance and texture. Any defects that may project through surface coatings or coverings shall be ground smooth.
 - b. Apply floor hardener, as specified in Section 03 15 00, to all interior or under shelters slabs that are not scheduled to receive floor coverings.

3.06 CURING

A. General Requirements:

1. Freshly placed concrete shall be protected from rain and flowing water. Concrete shall not be allowed to dry out from the time it is placed until the expiration of the specified curing period. Methods of curing unless otherwise approved by the Engineer shall be as follows:
 - a. Concrete shall be kept wet with clean water for period of 7 days after placing. Each day forms are left in place shall suffice for wetting.
 - b. Curing may be accomplished by leaving forms sufficiently wet to prevent opening of joints.

- c. After forms are removed, an approved membrane forming curing compound to seal water in the concrete shall be applied to all concrete except surfaces which are to receive future concrete or mortar.
 - 2. Curing shall begin immediately after concrete placement
 - 3. Maintain concrete temperature above 50°F for minimum 7 days
 - 4. Protect from weather extremes
 - B. Environmental Structures:
 - 1. Minimum 7-day wet cure
 - 2. Temperature monitoring
 - 3. Enhanced moisture retention
- 3.07 FIELD QUALITY CONTROL
- A. Compressive Strength Testing
 - 1. Sampling Frequency: Collect concrete cylinders for each of the following volumes:
 - a. Elevated slabs or floors, ceilings, supporting walls, beams, columns, and architectural concrete: One set of cylinders for each pour of 25 CY or less plus one additional set for each additional 25 CY or fraction thereof.
 - b. Slabs on grade, foundations, footings, non-supporting walls, paving, pedestals, and all other locations: One set of cylinders for each pour of 50 CY or less plus one additional set for each additional 50 CY or fraction thereof.
 - 2. Concrete Cylinder Test:
 - a. During construction, for each volume of concrete noted above, a minimum of four cylinder samples must be taken.
 - b. The following information shall be documented for each cylinder set
 - 1) Batch Information including mix number, design strength, truck or ticket number, time of batch, and time of sample
 - 2) Placement information including major structure name and pour location (i.e. main slab or west wall).
 - 3) Field measurements for each sample set including slump, concrete temperature, concrete air content, sample weight, and ambient air temperature.
 - c. Concrete cylinders shall be secured with tamper proof locks in secure boxes at the job site. Neither Contractor nor Engineer shall have access to the Testing Agency's sample box.
 - d. Concrete cylinders, after curing as required by the Testing Agency, shall be taken off site for storage and testing.

- e. Concrete cylinders shall be tested for compressive strength according to the following:
 - 1) One cylinder tested at 7 days
 - 2) Two cylinders tested at 28 days
 - 3) One cylinder held for additional testing if required
 - 4) Contractor may contract with the Testing Agency to take additional cylinder samples at his own cost. Contractor's cylinders must be indistinguishable from contract cylinders and be stored and tested as contract cylinders.

B. Field Measured Test:

- 1. Slump: Every concrete delivery
- 2. Air content: Every concrete delivery
- 3. Concrete Temperature: Every concrete delivery

C. Contractor's Role:

- 1. Contractor shall assist the Testing Agency with acquiring samples and documenting conditions.
- 2. Contractor shall provide tools and equipment if required to obtain samples.
- 3. Contractor shall provide a water source for cleaning of tools and equipment utilized by the Testing Agency.
- 4. The Contractor shall note the approximate placement location of each batch sampled on the as-built drawings.

D. Additional Testing for Environmental Structures:

- 1. Water tightness testing per Section 01 45 16

3.08 PROTECTION

A. Temperature Protection:

- 1. Cold weather procedures per ACI 306R
- 2. Hot weather procedures per ACI 305R
- 3. Maximum temperature differential: 35°F

B. Loading Protection:

- 1. No construction loads until 75% strength, provide testing to show strength if prior to 28 days after placing.
- 2. No vehicle loads until full strength
- 3. Protect from vibration and impact

3.09 IMPERFECT AND DAMAGED WORK REPAIR

- A. Imperfect and damaged work and materials shall be satisfactorily removed. New work and new materials which are in accord with the requirements of the Drawings and Construction Specifications shall be furnished and installed at no additional expense to the Owner.
- B. Removal of imperfect and damaged work and materials and the installation of new work and materials shall be accomplished in a manner which will not impair the strength of the structure.

3.10 CLEANING

- A. Upon completion of work, all forms, equipment, protective covering and rubbish resulting from the work shall be removed from the premises.
- B. Finished concrete surfaces shall be left in a clean condition satisfactory to the Engineer and Owner. Surfaces shall be free of mud, oils, or other stains.

END OF SECTION

SECTION 03 45 00

ARCHITECTURAL PRECAST CONCRETE

PART 1 - GENERAL:

1.01 SCOPE:

- A. The work performed under this section of the specifications shall include all labor, material, equipment, services and supervision required for the manufacture of the architectural precast concrete units indicated on the drawings.

- 1. Sill and Watertable units.
- 2. Wall Caps.

1.02 RELATED SECTIONS:

- A. Section 03 3000 - Cast-In-Place Concrete.
- B. Section 04 2000 - Unit Masonry Assemblies.
- C. Section 05 5000 - Metal Fabrications.
- D. Section 07 6500 - Flexible Flashing.
- E. Section 07 9200 - Joint Sealants.
- F. Section 09 9100 - Paints & Coatings.

1.03 REFERENCES:

- A. American Concrete Institute (ACI):
 - 1. ACI318 - Building Code Requirements for Reinforced Concrete.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A615 - Spec for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - 2. ASTM A767/A767M - Spec for Zinc Coating (Galvanized) Steel Bars for Concrete Reinforcement.
 - 3. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - 4. ASTM C33 - Spec for Concrete Aggregates.
 - 5. ASTM C150 - Spec for Portland Cement.
 - 6. ASTM C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volume Method.
 - 7. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.

8. ASTM C 426 - Standard Test Method for Linear Shrinkage of Concrete Masonry Units.
9. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete.
10. ASTM C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
11. ASTM C 1194 - Standard Test Method for Compressive Strength of Architectural Cast Stone.
12. ASTM C 1195 - Standard Test Method for Absorption of Architectural Cast Stone.
13. ASTM C 1364 - Standard Specification for Architectural Cast Stone.

C. Precast Concrete Institute (PCI):

1. PCI Design Handbook for Precast and Pre-stressed Concrete.
2. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.

1.04 QUALITY ASSURANCE:

- A. Production of architectural precast concrete units shall comply with the provisions of Precast Concrete Institute (PCI) MNL 117, "Manual for Quality Control for Production of Architectural Precast Concrete Products".
- B. A minimum of 5 years production experience in architectural precast concrete work of quality and scope for a specified project is required.
- C. Manufacture shall be by a company specializing in providing architectural concrete products and services.
- D. Manufacture of architectural precast concrete units shall meet the allowable tolerances as set forth in PCI MNL 117.
- E. A competent Erection Contractor having experience in the erection of this type of material shall perform installation of architectural precast concrete units.

1.05 DEFINITIONS

- A. Cast Stone: An architectural stone unit manufactured to copy fine grain texture and color of natural cut stone used in unit masonry applications. Meets ASTM C 1364 requirements.
- B. Dry Cast Concrete Products: Manufactured from zero-slump concrete.
 1. Vibrant Dry Hand Tamp Casting Method: Vibratory compaction by hand tamp of earth-moist, zero-slump concrete against rigid mold until it is densely compacted.

1.02 SUBMITTALS:

- A. Manufacturer shall submit for approval, prior to production of precast units, one sample representative of the actual elements as to quality and type of finish. The sample shall be at least 6" x 6" x 1" in size.

- B. Test cylinders and product data shall be available for review.
- C. The Manufacturer shall submit shop drawings for approval prior to undertaking any work. These drawings shall show all finishes, dimensions, connection, and related details.

1.03 DELIVERY, HANDLING AND STORAGE:

- A. Care shall be used in the delivery and handling of architectural precast concrete units and in their storage at the jobsite. Members shall be handled in such a manner so as to prevent physical damage.
- B. Products shall be stored and handled in such a manner that prevents damage and protects the product. The Manufacturer assumes no responsibility for the storing of our product on job site.

1.04 WARRANTY:

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

PART 2 - PRODUCTS:

2.01 MANUFACTURER:

- A. Basis of Design: RockCast, by Reading Rock, Inc.
- B. Products of manufacturers listed below meeting indicated standard and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to approval of product list and samples:
 - 1. Arriscraft International.
 - 2. Continental Cast Stone.
- C. Section 01 6000 - Product Requirements; Product Selection Procedures; Substitutions: Permitted.

2.02 CAST STONE:

- A. Custom Cast Stone Units: RockCast's Custom Cast Stone Series.
 - 1. Compliance: ASTM C 1364.
 - 2. Casting Method: Vibrant dry hand tamp.
 - 3. Texture: Smooth.

2.03 CAST STONE MATERIALS:

- A. Portland Cement: ASTM C 150, Type I or III. White and/or gray as required to match specified color.

- B. Coarse Aggregates: ASTM C 33, except for gradation. Granite, quartz, or limestone.
- C. Fine Aggregates: ASTM C 33, except for gradation. Manufactured or natural sands.
- D. Pigments: ASTM C 979, except do not use carbon black pigments. Inorganic iron oxide pigments.
- E. Admixtures:
 - 1. Water Reducing, Retarding, and Accelerating Admixtures: ASTM C 494.
 - 2. ASTM C 260 for air-entraining admixtures
 - 3. Other admixtures: integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
 - 4. ASTM C 618 for mineral admixtures
 - 5. ASTM C 989 for ground granulated blast-furnace slag
- F. Water: Potable.
- G. Reinforcing Bars: ASTM A 615, deformed steel bars. Epoxy coated or galvanized when covered with less than 1-1/2 inches of material.
 - 1. Galvanized Coating: ASTM A 767.

2.04 SHAPES AND SIZES:

- A. Sills and Watertables:
 - 1. RockCast SL200 sill profile, nominal 5" high x 8" deep with 4" x 1¼" chamfer; use at transition from natural stone veneer to fiber cement siding.
 - 2. Provide in longest lengths practical with right and left returns furnished at outside corners.
- B. Wall Caps:
 - 1. RockCast CO-200, widths as shown on drawings.
 - 2. Provide in longest lengths practical with right and left returns furnished at outside corners.

2.05 FINISH:

- A. Color: To be selected by Architect from manufacturer's full range of colors.

PART 3 - EXECUTION:

3.01 FABRICATION:

- A. Architectural precast concrete units shall be fabricated in accordance with the provisions of PCI MNL 117.

- B. Finishes shall match in texture and color the approved sample and actual finishing techniques shall be developed by the Manufacturer so as to meet the architectural specifications. Due to the nature of the product, slight variations in color will occur.
- C. The dimensions of precast concrete units shall be as indicated on the plans. Products shall be fabricated and furnished to the following tolerances:
 - 1. Bowing:
 - a. Bowing, Length of bow or $\frac{3}{4}$ " maximum.
 - b. Differential bowing, two adjacent members, $\frac{1}{4}$ "
 - 2. Warpage:
 - a. Maximum warpage of one corner from the nearest corner, $\frac{1}{16}$ "/ft. to nearest corner.
 - 3. Thickness: $-\frac{1}{8}$ ", $+\frac{1}{4}$ ".
 - 4. Squareness: $\frac{1}{8}$ " per 6ft. or $\frac{1}{4}$ " max, whichever is greater.
 - 5. Dimensions: 10" or under, $\pm\frac{1}{8}$ ".
 - 6. Weld plates, anchors and inserts: ± 1 " of centerline.
 - 7. Block outs and reinforcements: Within $\frac{1}{2}$ " or the indicated position to meet structural requirements.
 - 8. Length and width of block outs: $\pm \frac{1}{4}$ ".

3.02 ERECTION:

- A. A Competent Erection Contractor having experience in the erection of this type of material shall perform installation of architectural precast concrete units. If required, members shall be lifted by means of suitable lifting devices at points provided by the Manufacturer.
- B. The Erector shall execute a final clean down to remove dirt and stains that are direct result of the erection process.
- C. Any damage that occurs during the erection will be the responsibility of the Erector. These repairs will be deemed acceptable if the structural adequacy and/or aesthetic appearance are not impaired, subject to the approval of the Architect.
- D. After completion, any further soiling or damage to architectural precast concrete units is the responsibility of the General Contractor.

3.03 DAMAGE AND REPAIR:

- A. In house patching may be required by the Manufacturer prior to shipping. These repairs will be deemed acceptable if the structural integrity and/or aesthetic appearance are not impaired, subject to the approval of the Architect.

END OF SECTION

SECTION 03 62 00

NON-SHRINK GROUTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Non-shrink cementitious grout
2. Non-shrink epoxy grout
3. Grouting of base plates, bearing plates, and anchors
4. Grouting of equipment bases

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 03 30 00 - Cast-in-Place Concrete
2. Section 05 12 00 - Structural Steel
3. Section 43 05 13 - Common Work Results for Process Equipment

1.03 REFERENCES

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete
2. ACI 318 - Building Code Requirements for Structural Concrete
3. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures
4. ACI 351.1R - Grouting between Foundations and Bases for Support of Equipment and Machinery
5. ACI 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete
6. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials

B. ASTM International:

1. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
2. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars

3. ASTM C191 - Test Methods for Time of Setting of Hydraulic Cement
4. ASTM C827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens
5. ASTM C939 - Test Method for Flow of Grout for Preplaced-Aggregate Concrete

1.04 SUBMITTALS

A. PRODUCT DATA:

1. Manufacturer's literature including specifications, installation instructions, independent laboratory test reports, temperature limitations, and clean-up requirements.
2. Documentation of compliance with ACI 351.1R requirements
3. Qualification data per ACI 355.4 for adhesive anchors

B. DESIGN MIXTURES:

1. Only premeasured, prepackaged materials supplied by the manufacturer shall be used.

1.05 QUALITY ASSURANCE

A. Comply with ACI 301, Section 1.6:

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Grout must be delivered in the original, unopened containers with labels intact identifying product and manufacturer. The date of manufacture must be clearly marked.

B. STORAGE:

1. Grout shall be stored in a dry covered location, protected from moisture and contamination, and maintained at a temperature between 40°F and 90°F.

1.07 PROJECT CONDITIONS

A. Environmental Requirements:

1. Install grout when temperatures remain between 40°F and 90°F
2. Maintain temperature range for minimum 24 hours before and after installation
3. Follow manufacturer's requirements for extreme temperatures

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Master Builders Solutions

2. Five Star Products
3. Euclid Chemical Company
4. Or approved equal

2.02 MATERIALS

A. Cementitious Non-Shrink Grout:

1. Pre-packaged, non-metallic, non-corrosive
2. ASTM C1107, Grade B or C
3. Minimum Compressive Strength:
 - a. 3,000 psi at 1 day
 - b. 3,500 psi at 3 days
 - c. 5,000 psi at 28 days
4. No chlorides or aluminum powder
5. Plastic Volume Change: No shrinkage (0.0%) and a maximum of 4.0% expansion according to ASTM C-827.
6. Hardened Volume Change: No shrinkage (0.0%) and a maximum of 0.3% expansion on the hardened state.
7. Placeability: Capable of a flowable consistency (124- 145 flow) when tested according to ASTM C-109. Standard nonshrink cement-based grout shall have a minimum initial set time of 60 minutes when tested according to ASTM C-191.
8. Soundness: No chlorides, metallic substances, aluminum powder or other materials known to compromise long term durability.

B. Epoxy Grout:

1. Three-component, 100% solids
2. Pre-measured and packaged
3. Minimum Compressive Strength:
 - a. 5,000 psi at 1 day
 - b. 10,000 psi at 7 days
4. Maximum creep resistance
5. Chemical resistant

C. Water:

1. Water for grout mixing shall be clean, potable, free from deleterious materials, and non-staining.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify:

1. Concrete surfaces clean and sound
2. Base plates and equipment properly positioned
3. Anchor bolts clean and properly positioned
4. Adequate clearance for grouting

3.02 PREPARATION

A. Surface Preparation:

1. Remove laitance, oil, grease
2. Roughen concrete to 1/4 inch amplitude
3. Clean with oil-free compressed air
4. Pre-soak concrete for 24 hours

B. Forming:

1. Construct leak-proof forms where required.
2. Provide minimum 1-inch head height
3. Allow for heat of hydration expansion
4. Provide adequate venting

3.03 MIXING

A. Cementitious Non-Shrink Grout:

1. Non-shrink grout shall be premixed and packaged
2. Prepare as recommended by the manufacturer.
3. Mix to uniform consistency
4. Do not retemper

B. Epoxy Grout:

1. Mix all components in clean container

2. Follow manufacturer's sequence and timing
3. Mix to uniform color and consistency
4. Do not vary proportions

3.04 INSTALLATION

A. General Requirements:

1. Place grout quickly and continuously
2. Place from one side only
3. Maintain minimum 1/2 inch thickness or as recommended by the manufacturer.
4. Maximum 6-inch thickness per lift
5. Ensure no voids or air pockets

B. Temperature Requirements:

1. Maintain substrate between 40°F and 90°F
2. Maintain grout between 50°F and 90°F
3. Shade from direct sunlight as needed

3.05 CURING

A. Cementitious Non-Shrink Grout:

1. Begin curing immediately per Manufacturer's recommendation.
2. Protect from excessive heat, cold, and vibration
3. Remove forms after grout reaches initial set

B. Epoxy Grout:

1. Cure per manufacturer's requirements
2. Maintain temperature requirements
3. Protect from moisture until fully cured

3.06 FIELD QUALITY CONTROL

A. Testing:

1. The following testing shall be performed when requested by the Engineer.
 - a. Compressive strength testing per ASTM C109
 - b. One set of 3 cubes per day or every 50 bags

- c. Flow cone testing per ASTM C939
- d. Other testing as directed by Engineer

B. Inspection:

- 1. Prior to and during placing the Contractor, under the direction of the Engineer, shall verify proper preparation, monitor mixing procedures, observe placement techniques, and document ambient conditions

3.07 PROTECTION

- A. Newly placed grout shall be protected from excessive heat or cold, vibration and impact, premature loading, excessive water, and contamination.

END OF SECTION

SECTION 04 05 19

MASONRY ANCHORAGE AND REINFORCING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. Section Includes: Seismic and non-seismic masonry veneer tie and anchor assemblies.

1. Related Requirements:

- a. Section 03 30 00 – Cast In Place Concrete.
- b. Section 04 05 23 – Masonry Accessories.
- c. Section 04 20 00 – Unit Masonry.
- d. Section 04 72 00 – Cast Stone Masonry.
- e. Section 05 12 00 – Structural Steel Framing.
- f. Section 06 10 00 – Rough Carpentry.
- g. Section 07 11 13 – Bituminous Dampproofing.
- h. Section 07 13 26 – Self-Adhering Sheet Waterproofing.
- i. Section 07 21 00 – Thermal Insulation.
- j. Section 07 24 19 – Exterior Insulation & Finish System with Moisture Drainage.
- k. Section 07 62 00 – Sheet Metal Flashing & Trim.
- l. Section 07 65 00 – Flexible Flashing.

1.03 REFERENCES:

- A. Reference Standards:

1. ASTM International (ASTM):

- a. ASTM A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- b. ASTM A580 Standard Specification for Stainless Steel Wire.

1.04 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination: Coordinate work of this Section with work of other trades for proper time and sequence to avoid construction delays. Comply with Section 01 3100 - Project Management and Coordination.
- B. Sequencing: Sequence work of this section in accordance with manufacturer=s written recommendations for sequencing construction operations.
- C. Scheduling: Schedule work of this Section in accordance with Section 01 3200 – Construction Progress Documentation.

1.05 ACTION SUBMITTALS:

- A. General: Submit listed submittals in accordance with Contract Conditions and Section 01 3300 - Submittal Procedures.
- B. Product Data: Submit specified products as follows:
 - 1. Manufacturer’s product data, including manufacturer’s SPEC-DATA product sheet.
 - 2. Manufacturer’s installation instructions.
 - 3. Catalog pages illustrating products to be included in project.
 - 4. Material Safety Data Sheets (MSDS).
- C. Samples: Submit 2 selection and verification samples of anchorage having dimensions of six inches.

1.06 INFORMATION SUBMITTALS:

- A. General: Submit listed submittals in accordance with Contract Conditions and Section 01 3300 - Submittal Procedures.
- B. Test and Evaluation Reports: Provide certified test reports showing compliance with specified performance characteristics and physical properties.
- C. Source Quality Control: Submit documentation verifying that components and materials specified in this Section are from single manufacturer.
 - 1. Manufacturer’s Reports: Manufacturer field reports specified.
 - 2. Qualification Statements:
 - a. Submit letter of verification for Manufacturer’s Qualifications.
 - b. Submit letter of verification for Installer’s Qualifications.

1.07 CLOSEOUT SUBMITTALS:

- A. General: Submit listed submittals in accordance with Contract Conditions and Section 01 3300 - Submittal Procedures.
- B. Warranty Documentation: Submit warranty documents specified.

1.08 QUALITY ASSURANCE:

A. Qualifications:

1. Manufacturer:
 - a. Having 25 years experience manufacturing components similar to or exceeding requirements of project.
 - b. Having sufficient capacity to produce and deliver required materials without causing delay in work.
 - c. Capable of providing field service representation during construction.
2. Installer: Acceptable to manufacturer, experienced in performing work of this section and has specialized in installation of work similar to that required for this project.

B. Mock-Up:

1. Purpose will be to judge quality of work, substrate preparation and material application.
2. Construct where directed by Architect in accordance with Section 01 4000 - Quality Requirements.
3. Construct to 64" wide x 80" high using proposed procedures and quality of work.
4. Locate where directed.
5. Do not proceed with work prior to receipt of written acceptance of mock-up. When accepted, mock-up will demonstrate minimum standard of quality required for this work.
6. Remove mock-up and dispose of materials when no longer required and when directed by Architect.

1.09 DELIVERY, STORAGE & HANDLING:

A. Delivery and Acceptance Requirements:

1. Deliver material in accordance with Section 01 6000 – Product Requirements and in accordance with manufacturer's written instructions.
2. Deliver materials in manufacturer's original packaging with identification labels intact and in sizes to suit project.

B. Storage and Handling Requirements:

1. Store materials protected from exposure to harmful weather conditions and as directed by manufacturer.

1.10 WARRANTY:

- ##### A. Warranty: Refer to Contract Conditions and Section 01 7836 – Warranties & Bonds for project warranty provisions.

1. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and does not limit, other rights Owner may have under other Contract Documents.
 - a. Warranty Term: One (1) year commencing on date of substantial completion.

PART 2 - PART 2 PRODUCTS:

2.01 MASONRY TIES AND ANCHORS:

A. Manufacturer: Hohmann & Barnard, Inc.

1. Contact: 30 Rasons Court, Hauppauge, NY, 11788-4206; Telephone: 800-645-0616, 631-234-0600; Fax: 631-234- 0683;. E-mail: weanchor@h-b.com; website: www.h-b.com.
2. Single Source Responsibility: Provide components and materials specified in this section from a single manufacturer.
3. Substitution Limitations:
 - a. Substitutions: In accordance with Section 01 6000 – Product Requirements.

B. Description:

1. Regulatory Requirements: In accordance with Section 01 4200 – References.
 - a. Compatibility: Ensure components and materials are compatible with specified accessories and adjacent materials.

C. Materials:

1. Anchors and Ties:
2. Stainless Steel: Type 304 to ASTM A167.
3. Wire:
 - a. Stainless Steel: Type 304 to ASTM A580.
4. Screw-Type Tie Barrel:
 - a. Stainless steel to ASTM 580.

D. Seismic and Non-Seismic Anchor Assemblies:

1. Anchor Assemblies:
 - a. Acceptable Material: Hohmann & Barnard, Inc.: Thermal Concrete 2-Seal Wing Nut Anchor for non-seismic applications.
2. Anchor:
 - a. Type: Drill screw type.

- b. Thickness: N/A.
 - c. Length: 2 inches (51 mm).
 - d. Width: N/A.
 - e. Finish: Stainless steel.
3. Washer: Optional insulation washer.

PART 3 - PART 3 EXECUTION:

3.01 EXAMINATION:

- A. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to masonry anchor and tie assembly installation.
- B. Verify that site conditions installed under other sections are in accordance with manufacturer's instructions prior to masonry anchor and tie assembly installation.
 - 1. Inform Architect of unacceptable conditions immediately upon discovery.
 - 2. Proceed with installation only after unacceptable conditions have been remedied.

3.02 PREPARATION:

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surface in accordance with manufacturer's written recommendations.

3.03 INSTALLATION:

- A. Coordinate installation of masonry anchor and tie assemblies.
- B. Accurately fit, align, securely fasten and install free from distortion or defects.

3.04 APPLICATION:

- A. Coordinate application of veneer masonry anchor and tie assemblies.

3.05 FIELD QUALITY CONTROL:

- A. Tests, Inspection: Coordinate field test with Section 01 4533 – Special Inspections.

3.06 CLEANING:

- A. Perform cleanup in accordance with Section 01 7700 – Closeout Procedures.
- B. Upon completion, remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 7700 – Closeout Procedures.

3.07 PROTECTION:

- A. Protect installed product from damage during construction in accordance with Section 01 7700 Closeout Procedures.
- B. Repair damage to adjacent materials caused by masonry veneer anchor and tie assembly installation.

END OF SECTION

SECTION 04 05 23

MASONRY ACCESSORIES

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DESCRIPTION OF WORK:

- A. This Section includes the following:
 - 1. Full height airspace maintenance and drainage material.
 - 2. Cell vents.
- B. Related Sections:
 - 1. Section 04 05 19 – Masonry Anchorage & Reinforcing.
 - 2. Section 04 20 00 – Unit Masonry Assemblies.
 - 3. Section 04 72 00 – Cast Stone Masonry.
 - 4. Section 07 21 00 – Thermal Insulation.
 - 5. Section 07 24 19 – Exterior Insulation & Finish System with Moisture Drainage.
 - 6. Section 07 62 00 – Steel Metal Flashing & Trim.
 - 7. Section 07 65 00 – Flexible Flashing.

1.03 REFERENCES:

- A. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS:

- A. Submit under provisions of Section 01 3300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.

1.05 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Minimum 5 years production of similar products.
 - B. Installer Qualifications: Minimum 5 years experience as a masonry installer.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
- A. Store products in manufacturer's unopened packaging until ready for installation.
- 1.07 WARRANTY:
- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Warranty Period: one (1) year commencing on Date of Substantial Completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturer: Keene Building Products; PO Box 241353, Mayfield Heights, Ohio 44124. Toll Free Tel: (877) 514-5336, Tel: (440) 605-1020. Fax: (440) 605-1120. Email: info@keeneBuilding.com. Web: http://www.KeeneBuilding.com.
- B. Products of manufacturers listed below meeting indicated standard and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to approval of product list and samples:
 - 1. Archovations, Inc.
 - 2. Hohmann and Barnard, Inc.
 - 3. Mortar Net Solutions.
 - 4. Wire-Bond.
- C. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 DRAINAGE MAT:

- A. Masonry Drainage Mat: Full-Height Airspace Maintenance and Cavity Mortar Control.
- B. Product Description: CAV-AIR-ATOR as manufactured by Keene Building Products.
 - 1. Physical Characteristics: Three-dimensional mat made up of an extruded polymer matrix of entangled monofilaments. Non-woven, breathable fabric heat laminated on one side of the product.
 - a. 1.00" thick.
 - b. 4.0' long.
 - c. 16" high.

2. Performance:
 - a. Drainage of moisture and ventilation in masonry cavity.
3. Material: UV stabilized polypropylene.
 - a. Class-A flame spread per ASTM E84.
 - b. Hydrophobic compound.
 - c. Resistant to chemicals.
 - d. Does not support mold growth.

2.03 CELL VENTS:

- A. Cell vents: Ultraviolet resistant polypropylene copolymer vent that is placed in the vertical head joints approximately every two feet to create a space for moisture to drain and vent in a brick cavity wall.
- B. Product: Cell Vent (#3601) as manufactured by Wire-Bond.
 1. Description:
 - a. Size: 3/8" wide x 2 1/2" high x 3 3/8" long.
 - b. Color: Clear.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION:

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 DRAINAGE MAT INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Inspection of Wall Conditions: Ensure that the wall is free from structural defects, that any membranes or flashing are properly installed, and that the final system will have a path for moisture to escape from the wall.

C. Installation for Brick:

1. Install first course of brick. Remove any mortar or debris from the cavity.
2. Place the drainage mat in the cavity with the filter fabric facing out.
3. The product does not require any fasteners. It will rest on the brick ties and be friction fit in the cavity.
4. Install subsequent courses of brick, reaching the next brick tie.
5. Repeat this process continuously throughout the full-height of the masonry cavity wall.
6. NOTE: At the bottom of the wall and above all through wall flashings, use multiple layers.

3.04 CELL VENT INSTALLATION:

- A. Place cell vents in open head joints of cavity wall located immediately above ledges and flashing, and at top of cavity wall, spaced 24 inches apart, unless otherwise shown.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL:

1.01 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.

1.02 DESCRIPTION OF WORK:

- A. This Section includes the following:

- 1. Concrete unit masonry.
- 2. Shot blast concrete masonry units.
- 3. Clay unit masonry in the form of brick.

- B. Related Sections:

- 1. Section 03 15 00 – Concrete Accessories.
- 2. Section 03 30 00 – Cast-In-Place Concrete.
- 3. Section 04 05 19 – Masonry Anchorage & Reinforcing.
- 4. Section 04 05 23 – Masonry Accessories.
- 5. Section 04 72 00 – Cast Stone Masonry.
- 6. Division 05 – Metal Work.
- 7. Section 06 10 00 – Rough Carpentry.
- 8. Section 06 40 23 – Interior Architectural Woodwork.
- 9. Section 07 11 13 – Bituminous Dampproofing.
- 10. Section 07 21 00 – Thermal Insulation.
- 11. Section 07 21 19 - Foamed-In-Place Masonry Insulation.
- 12. Section 07 24 19 – Exterior Insulation & Finish System with Moisture Drainage.
- 13. Section 07 62 00 – Sheet Metal Flashing & Trim
- 14. Section 07 65 00 – Flexible Flashing.
- 15. Section 07 92 00 – Joint Sealants.

16. Section 08 41 13 – Aluminum-Framed Entrances & Storefronts.
17. Section 09 22 16 – Non-Structural Metal Framing.
18. Section 09 91 00 – Paints & Coatings.
19. Section 10 14 16 – Plaques.
20. Section 10 14 19 – Dimensional Letter Signage.
21. Section 10 73 16 – Protective Covers.
22. Section 14 24 23 – Hydraulic Passenger Elevators
23. Section 31 31 00 – Soil Treatment.

1.03 SYSTEM PERFORMANCE REQUIREMENTS:

- A. Provide unit masonry that develops the following installed compressive strengths ($f'm$):
 1. For concrete unit masonry: As follow:
 - a. $f'm = 1,500$ psi.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each different masonry unit, accessory and other manufactured product installed.
- C. Samples for verification purposes of the following:
 1. Accessories embedded in the masonry.
- D. Material certificates for the following signed by manufacturer and Contractor certifying that each material complies with requirements.
 1. Each different cement product required for mortar and grout including name of manufacturer, brand, type and weight slips at time of delivery.
- E. Material test reports from a qualified independent testing laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:
 1. Grout mixes. Include description of type and proportions of grout ingredients.
 2. Masonry units.
- F. Cold-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.
- G. Hot-weather construction procedures evidencing compliance with requirements specified in referenced unit masonry standard.

- H. Construct a sample wall panel approximately 64 inches wide by 80 inches high to demonstrate aesthetic effects and qualities of materials and execution. Coordinate location of sample wall panel with Owner prior to constructing.

1.05 QUALITY ASSURANCE:

- A. Unit Masonry Standard: Comply with ACI 530.1/ASCE 6 “Specifications for Masonry Structures,” except as otherwise indicated.
- B. Fire Performance Characteristics: Where indicated, provide materials and construction identical to those of assemblies whose fire resistance has been determined per ASTM E 119 by a testing and inspecting organization, be equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.
- C. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- D. Single Source Responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.06 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver masonry materials to protect in undamaged condition.
- B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes. If units become wet, do not place until units are in an air-dried condition.
 - 1. Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type II units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.
- C. Store cementitious materials off the ground, under cover and in dry location.
- D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- E. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt and oil.

1.07 PROJECT CONDITIONS:

- A. Protection of Masonry: During erection, cover top of walls with waterproof sheeting at end of each day’s work. Cover partially completed structures when work is not in progress.
 - 1. Extend cover a minimum of 60" down both sides and hold cover securely in place.

- B. Stain Prevention: Prevent grout, mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surfaces.
 2. Protect sills, ledges and projections from droppings of mortar.
 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes from mortar droppings.
- C. Cold Weather Construction:
1. Do not lay masonry units, which are wet or frozen.
 2. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
 3. Remove masonry damaged by freezing conditions.
- D. Hot-Weather Construction: Comply with referenced unit masonry standard.
- E. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout.
1. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10° F (6° C).
 - a. 40° F (4° C) to 32° F (0° C):
 - 1) Mortar: Heat mixing water to produce mortar temperature between 40° F (4° C) and 120° F (49° C).
 - 2) Grout: Follow normal masonry procedures.
 - b. 32° F (0° C) to 25° F (-4° C):
 - 1) Mortar: Heat mixing water and sand to produce mortar temperatures between 40° F (4° C) and 120° F (49° C); maintain temperature of mortar on boards above freezing.
 - 2) Grout: Heat grout materials to 90° F (32° C) to produce in place grout temperature of 70° F (21° C) at end of work day.
 - c. 25° F (-4° C) to 20° F (-7° C):
 - 1) Mortar: Heat mixing water and sand to produce mortar temperatures between 40° F (4° C) and 120° F (49° C); maintain temperature of mortar on boards above freezing.
 - 2) Grout: Heat grout materials to 90° F (32° C) to produce in place grout temperature of 70° F (21° C) at end of work day.

- 3) Heat both sides of walls under construction using salamanders or other heat sources. Use windbreaks or enclosures when wind is in excess of 15 mph.
- d. 20° F (-7° C) and below:
 - 1) Mortar: Heat mixing water and sand to produce mortar temperatures between 40° F (4° C) and 120° F (49° C).
 - 2) Grout: Heat grout materials to 90° F (32° C) to produce in place grout temperature of 70° F (21° C) at end of work day.
 - 3) Masonry Units: Heat masonry units so that they are 20° F (-7° C) at time of laying.
 - 4) Provide enclosure and auxiliary heat to maintain an air temperature of at least 40° F (4° C) for 24 hours after laying units.
 - 5) Do not heat water for mortar and grout to above 160° F (71° C).
- F. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.
 1. 40° F (4° C) to 32° F (0° C):
 - a. Protect masonry from rain or snow for at least 24 hours by covering with weather-resistive membrane.
 2. 32° F (0° C) to 20° F (-7° C):
 - a. Completely cover masonry with weather-resistive membrane for at least 24 hours.
 3. 25° F (-4° C) to 20° F (-7° C):
 - a. Completely cover masonry with weather-resistive insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.
 4. 20° F (-7° C and below):
 - a. Except as otherwise indicated, maintain masonry temperature above 32° F (0° C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40° F (4° C) for 48 hours.

PART 2 - PRODUCTS:

2.01 CLAY MASONRY UNITS:

- A. General: Comply with the following requirements applicable to each form of brick required.
- B. Face Brick Standard: Comply with ASTM C 216 and as follows:

1. Grade and Unit Compressive Strength: Provide units of grade and minimum average net area compressive strength indicated below:
 - a. Grade: SW.
 - b. Compressive Strength: 8,000 p.s.i.
 - c. Type: FBA
 - C. Size: Provide bricks manufactured to the following actual dimensions within tolerances specified in ASTM C 216.
 1. Standard Modular: 3-5/8" thick x 2-1/4" high x 7-5/8" long.
 - D. Application: Use where indicated for exposed and concealed locations.
 - E. Special molded shapes: Provide where indicated and as follows:
 1. For applications requiring brick of form, color, texture, and size on exposed surfaces that cannot be produced by sawing standard brick sizes.
 2. For applications where stretcher units cannot accommodate special conditions including those at corners, movement joints, bond beams, sashes and lintels.
 3. Provide units without cores or frogs and with all exposed surfaces finished for ends of sills, caps, and similar applications that expose brick surfaces that otherwise would be concealed from view.
 - F. Color: To be selected by Owner.
- 2.02 CONCRETE MASONRY UNITS:
- A. General: Comply with referenced unit masonry standards and the requirements indicated below applicable to each form of concrete masonry unit required.
 1. Provide special shapes where indicated and as follows:
 - a. For lintels, corners, jambs, sash, control joints, sills, headers, bonding and other special conditions.
 - b. Provide square-edged units for outside corners, except where indicated as bullnose.
 2. Size: Provide concrete masonry units complying with requirements below for size that are manufactured to specified face dimensions within tolerances specified in the applicable referenced ASTM specifications for concrete masonry units.
 - a. Hollow Load-Bearing Concrete Masonry Units:
 - 1) Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual, respectively) x thickness indicated.
 - b. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.
 - 1) Shot-Blast Block: #4201 by Echelon.

- B. Hollow Load-Bearing Concrete Masonry Units: Comply with the latest revision of ASTM C 90, Grade N, and as follows:

1. Unit Compressive Strength:

- a. Not less than the unit compressive strengths required to produce concrete unit masonry construction of compressive strength indicated.
- b. Weight Classification: Normal weight.

- C. UL-Labeled Concrete Masonry Units: Provide where fire-resistant-rated partitions are indicated/required.

2.03 MORTAR AND GROUT MATERIALS:

A. Materials:

1. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.
2. Ready-Mixed Mortar: Cementitious materials, water and aggregate complying with requirements specified in this article, combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142.
3. Hydrated Lime: ASTM C 207, Type S.
4. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.
5. Aggregate for Grout: ASTM C 404.
6. Water: Clean and potable.

2.04 MISCELLANEOUS MASONRY ACCESSORIES:

- A. Preformed Control Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Styrene-Butadiene Rubber Compound: ASTM D 2000, Designation M2AA-805.

- B. Non-Metallic Expansion Joint Strips: Premolded, filler strips complying with ASTM D 1056, Type 2 (closed cell), Class A (cellular rubber and rubber-like materials with specific resistance to petroleum base oils), Grade 1 (compression-deflection range of 2-5 p.s.i.), compressible up to 35%, of width and thickness indicated, formulated from the following material:

1. Neoprene.

2.05 MASONRY CLEANERS:

- A. Job-Mixed Detergent Solution: Solution of trisodium phosphate (1/2 cup dry measure) and laundry detergent (1/2 cup dry measure) dissolved in one gallon of water.

2.06 MORTAR AND GROUT MIXES:

- A. General: Do not add admixtures including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
- B. Mixing: Combine and thoroughly mix cementitious, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, for types of mortar required, unless otherwise indicated.
 - 1. Limit cementitious materials in mortar to Portland cement-lime.
 - 2. Use Type M mortar for CMU masonry below grade and in contact with earth, and where indicated.
 - 3. Use Type S mortar for CMU masonry above grade.
- D. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pig-to-cement ratio of 1-to-10, by weight.
 - 1. Shot-blast block: Coosa Brown.
 - 2. Clay masonry units: Coosa Antique Buff.
- E. Grout for Unit Masonry: Comply with ASTM C 476 for grout for use in construction of reinforced and nonreinforced unit masonry. Use grout of consistency indicated or if not otherwise indicated, of consistency (fine or coarse) at time of placement, which will completely fill all spaces intended to receive, grout.
 - 1. Use fine grout in grout spaces less than 2" in horizontal direction, unless otherwise indicated.
 - 2. Use coarse grout in grout spaces 2" or more in least horizontal dimension, unless otherwise indicated.

PART 3 - EXECUTION:

3.01 INSTALLATION, GENERAL:

- A. Comply with referenced unit masonry standard and other requirements indicated applicable to each type of installation included in Project.
- B. Do not wet concrete masonry units.
- C. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- D. Thickness: Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls to the actual thickness of the masonry units, using units of nominal thickness indicated.

- E. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- F. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
- G. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.
 - 1. Use dry cutting saws to cut concrete masonry units.
- H. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.
- I. Do not proceed until unsatisfactory conditions have been corrected.

3.02 CONSTRUCTION TOLERANCES:

- A. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.
- B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surfaces of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.
- C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
- D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".
- E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

3.03 LAYING MASONRY WALLS:

- A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.
- C. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than 4" horizontal face dimensions at corners or jambs.

- D. One-half running bond with vertical joint in each course centered on units in courses above and below.
 - E. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.
 - F. Stopping and Resuming Work: Rack back 1/2 unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.
 - G. Built-in Work: As the work progresses, built-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.
 - 1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
 - 2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
 - 3. Fill cores in hollow concrete masonry units with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.
- 3.04 INSTALLATION OF REINFORCED UNIT MASONRY:
- A. General: Install reinforced unit masonry to comply with requirements of referenced unit masonry standard.
 - B. Temporary Formwork: Construct formwork and shores to support reinforced masonry elements during construction.
 - 1. Construct formwork to conform shape, line, and dimensions shown. Make sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - C. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.
 - D. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- 3.05 MORTAR BEDDING AND JOINTING:
- A. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
 - B. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.

- C. Cut joints flush for masonry walls, which are to be concealed or to be covered by other materials, unless otherwise indicated.
- D. For CMU masonry, tool exposed joints slightly concave using a jointer larger than joint thickness, unless otherwise indicated.
- E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units, which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

3.06 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY:

- A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes.
- B. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.
- C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
 - 1. Provide continuity with horizontal joint reinforcement using prefabricated "T" units.

3.07 CAVITIES/ AIR SPACES:

- A. Keep cavities/ air spaces clean of mortar droppings and other materials during construction. Strike joints facing cavities/ air spaces flush.
- B. Tie exterior wythe to back-up with continuous horizontal joint reinforcing, unless indicated otherwise.

3.08 MOVEMENT (CONTROL AND EXPANSION) JOINTS:

- A. General: Provide vertical and horizontal expansion, control and expansion joints in masonry where indicated or required. Build-in related items as the masonry work progresses. Do not form a continuous span through movement joints, unless provisions are made to prevent in-plane restraint of wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Install preformed control joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick made from clay or shale as follows:
 - 1. Build flanges of factory-fabricated expansion joint units into masonry.
 - 2. Built in joint fillers where indicated.
 - 3. Form open joint of width indicated, but not less than 3/8" for installation of sealant and backer rod specified in Division 7- Section "Joint Sealers". Maintain joint free and clear of mortar.

3.09 LINTELS:

- A. Install steel lintels where indicated.
- B. For hollow concrete masonry unit walls, use specially formed U-shaped lintel units with reinforcement bars placed as indicated and filled with concrete, unless otherwise indicated.
- C. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.

3.10 REPAIRING, POINTING AND CLEANING:

- A. Remove and replace masonry units that are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units. Install new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film or waterproof masking tape.
 - 4. Wet wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean brick by means of bucket and brush hand cleaning method described in BIA "Technical Note No. 20 Revised" to clean brick masonry made from clay or shale, except use masonry cleaner indicated below:
 - 6. Detergent
 - 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain present on exposed surfaces.
- D. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer that ensures unit masonry is without damage and deterioration at time of Substantial Completion.

3.11 MASONRY WASTE DISPOSAL:

- A. Remove excess masonry waste and legally dispose of off the Owner's property.

END OF SECTION

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL:

1.01 SUMMARY

A. This Section includes the following:

1. Cold formed metal framing (CFMF) for use in exterior assemblies and where shown for interior applications. Products labeled as light gage metal framing (LGMF) are included as if labeled CFMF.

1.02 SUBMITTALS

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated. Provide load tables and engineering calculations indicating compliance with loading and deflection requirements. Identify applicable details and components. Occupancy Category shall be III, design wind load 120 mph, and seismic site classification "C".
- B. Shop Drawings: Provide shop drawings for any components and/or installations not fully dimensioned in manufacturer's product data.

Include placing drawings for framing members showing size and gage designations, number, type, location and spacing. Indicate supplemental strapping, bracing, splices, bridging, accessories and details for proper installation. Specify type, capacity and spacing of screws and other fasteners.

- C. Calculations and shop drawings shall be sealed by a licensed Georgia Professional Engineer indicating compliance.
- D. Welding certificates.
- E. Qualification Data
- F. Product Test Reports

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this project and whose work has resulted in construction with a record successful in service performance.
- B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer. Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members." System shall be designed to comply with loading requirements of International Building Code 2006.
- C. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements.

- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
 - E. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - F. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 - G. Fabricator and installer shall be experienced in CFMF systems of similar scope and design.
 - H. Maximum Deflection: Assemblies shall be sized and selected for a maximum deflection of L/600 for masonry veneers and L/360 for other veneers at a basic wind speed as indicated above. Provide additional loading for end zones.
 - I. Allowance Tolerance: Not to exceed +/-
- 1.04 DELIVERY, STORAGE, AND HANDLING
- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:
 - 1. Alabama Metal Industries Corp.
 - 2. Clark Steel Framing Systems
 - 3. Dale/Incor
 - 4. Superior Steel Studs, Inc.
 - 5. Unimast
 - 6. United States Steel
 - 7. Wheeling Corrugating Co.

2.02 MATERIALS

- A. System Components: Manufacturer's standard load-bearing steel studs and joists of type, size, shape, and gage to comply with requirements. Provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners and accessories for a complete metal framing system.
- B. Materials and Finishes:
 - 1. For 16 gage and heavier units, fabricate metal framing components of Structural Quality steel sheet with a minimum yield point of 50,000 psi, meeting requirements of ASTM A653 and ASTM A924.
 - 2. For 18 gage and lighter units, fabricate metal framing components of Structural Quality steel sheet with a minimum yield point of 33,000 psi, meeting requirements of ASTM A653 and A924.
 - 3. Provide galvanized finish to metal framing components complying with ASTM A924 for minimum G 60 coating.
 - 4. Provide nuts, bolts, washers, screws and other fasteners with corrosion resistant plated finish.
 - 5. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.
 - 6. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A780.

2.03 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0329 inch.
 - 2. Flange Width: 1-5/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure.
- D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.04 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers, knee braces, and girts.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.05 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.
- B. Anchor Rods: ASTM F 1554, Grade 55, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

- F. Welding Electrodes: Comply with AWS standards.

2.06 MISCELLANEOUS MATERIALS

- A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.07 FABRICATION

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb and square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.
 - 2. Fabricate framing assemblies using jigs or templates to hold members in proper alignment and position and to assure consistent component placement.
 - 3. Exterior components shall be a minimum of 18 gage, including studs and runners.
 - 4. Cut framing members by sawing or shearing; do not torch cut.
 - 5. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 6. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 12 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - PART 3 – EXECUTION:

3.01 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install in compliance with ASTM C1007.
- C. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for loads involved, except do not exceed 24 inches on center spacing for nail or power-driven fasteners or 16 inches on center for other types of attachment. Provide fasteners at corners and ends of tracks.
- D. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges. Set studs plumb and true to line. Erect studs such that punchouts are aligned. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure. Space studs at 16 inches on center except as otherwise shown. Axially loaded studs shall have full contact with web of tracks.

- E. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are to support fixtures, equipment, services, casework, heavy trim and furnishings and similar work attached to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
- F. Frame wall openings larger than 2 feet square with a minimum of double studs at each jamb of frame. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding and space jack studs same as full height studs of wall. Provide additional support at headers and sills of openings to span width and resist wind loads.
- G. Slip joints for deflection: Where stud system is installed as infill between structural components or installed where it bypassed floor or roof framing or in other conditions subject to deflection, install such that these axial loads are not transferred to the CFMF system as follows:
 - 1. Infill: Provide deflection space and restraining deflection track or angles at head that allows vertical movement of the studs.
 - 2. Bypass: Provide slide clip attachment that allows the stud vertical movement.
 - 3. Allow for deflection of structural members equal to $L/360$. Provide additional deflection space if dead loads have not yet been applied to structure. Allow a minimum of $\frac{1}{2}$ inch.
- H. Install horizontal (bridging) stiffeners in stud system, spaced (vertical distance) at not more than 48 inches on center. Weld at each intersection. Bridging shall be not less than $1\frac{1}{2}$ " x 16 gage cold rolled channel attached to center of stud with a minimum of 16 gage clip angle. Bridging not required where both flanges are covered with a maximum of $\frac{1}{2}$ inch gypsum board or equivalent with fasteners at 8 inch on center unless indicated otherwise on drawings. Provide diagonal bracing at corners and other conditions to resist wind loads.
- I. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
- J. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- K. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- L. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- M. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- N. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- O. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of $\frac{1}{8}$ inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
 1. Stud Spacing: 24 inches maximum.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 1. Install single-leg deflection tracks and anchor to building structure.
 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 3. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
 4. Connect drift clips to cold formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 2. Install solid blocking at centers indicated on Shop Drawings.
 3. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 4. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 5. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.05 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.
- C. Field Painting: Touch up damaged shop-applied protective coatings. Use compatible primer for prime coated surfaces; use galvanizing repair system for galvanized surfaces.

END OF SECTION

SECTION 05 50 00

FERROUS METAL FABRICATIONS

PART 1 - GENERAL:

1.01 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.

1.02 SUMMARY:

- A. Definition: Metal fabrications include items made from iron and steel shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere.
- B. This section includes the following metal fabrications:
 - 1. Steel pipe railings.
 - 2. Pipe bollards/guards.
 - 3. Metal stairs.
 - 4. Rough hardware.
 - 5. Miscellaneous steel trim.
 - 6. Miscellaneous framing and supports for the following:
 - a. Applications where framing and supports are not specified in other sections.
- C. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 03 – Concrete.
 - 2. Section 04 0519 – Masonry Anchorage & Reinforcing.
 - 3. Section 04 2000 – Unit Masonry Assemblies.
 - 4. Section 04 7200 – Cast Stone Masonry.
 - 5. Section 05 1200 – Structural Steel Framing.
 - 6. Section 05 4000 – Cold Formed Metal Framing.
 - 7. Section 06 1000 – Rough Carpentry.
 - 8. Section 09 9100 – Paintings & Coatings.
 - 9. Division 26 – Electrical.
 - 10. Division 27 – Communications.

11. Section 32 3119 – Cantilever Slide Gate.

1.03 RAILING SYSTEM STANDARDS:

A. ASTM International:

1. ASTM E 894 Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
2. ASTM E 935 Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
3. ASTM E 985 Specification for Permanent Metal Railing Systems and Rails for Buildings.
4. ASTM E 1481 Terminology of Railing Systems and Rails for Buildings.

B. American Society of Civil Engineers:

1. ASCE 7 Minimum Design Loads for Buildings and Other Structures.

C. American National Standards Institute:

1. ANSI A 117.1 Guidelines for Accessible and Usable Buildings and Facilities.
2. ANSI A 1264.1 Safety Requirements for Workplace Floor and Wall Openings, Stairs, and Railing Systems.

D. National Fire Protection Association:

1. NFPA 101 Life Safety Code.

1.04 SYSTEM PERFORMANCE REQUIREMENTS:

A. Structural Performances: Design, engineer, fabricate, and install the following metal fabrications to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective components of each metal fabrication.

1. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated loads of 300 lbs applied at any point non-concurrently, vertically downward, or horizontally.
2. Handrails Not Serving as Top Rails: Capable of withstanding the following loads applied as indicated:
 - a. Concentrated loads of 200 lbs applied at any point non-concurrently, vertically downward, or horizontally.
3. Infill Area of Guardrail Systems: Capable of withstanding a horizontal concentrated load of 200 lbs applied to one square foot at any point in the system including panels, intermediate rails, balusters, or other elements composing the infill area.
4. Treads of Steel Stairs: Capable of withstanding a uniform load of 100 lbs per square foot or a concentrated load of 300 lbs on an area of 4 square inches located in the center of the tread, whichever produces the greater stress.

1.05 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data for products used in miscellaneous metal fabrications, including paint products and grout.
- C. Shop Drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other sections.
 - 1. Where installed metal fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis that has been signed and sealed by the qualified professional engineer who was responsible for their preparation.
- D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under “Quality Assurance” article.
- E. Qualification data for firms and persons specified in “Quality Assurance” article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Architects and Owners, and other information specified.

1.06 QUALITY ASSURANCE:

- A. Fabricator Qualifications: Firm experienced in successfully producing metal fabrication similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Installer Qualifications: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.
- C. Qualify welding processes and welding operators in accordance with AWS D1.1 “Structural Welding Code – Steel,” D1.2 “Structural Welding Code – Aluminum,” D1.3 “Structural Welding Code- Sheet Steel” and D1.6 “Structural Welding Code – Stainless Steel.”
 - 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.
- D. Engineer Qualifications: Professional engineer licensed to practice in jurisdiction where project is located and experienced in providing engineering services of the kind indicated that have resulted in the successful installation of metal fabrications similar in material, design, and extent to that indicated for this Project.

1.07 PROJECT CONDITIONS:

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.
 - 1. Provide allowance for trimming and fitting at project site.

PART 2 - PRODUCTS:

2.01 FERROUS METALS:

- A. Metal Surfaces, General: For metal fabrications exposed to view upon completion of the work, provide materials selected for their surface flatness, smoothness and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheets.
- B. Steel Plates, Shapes and Bars: ASTM A 36.
- C. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
 - 1. Black finish, unless otherwise indicated.
 - 2. Galvanized finish for exterior installations and where indicated.
 - 3. Type F, standard weight (Schedule 40), unless another weight, type, and grade are required by structural loads.
- E. Gray Iron Castings: ASTM A 48, Class 30.
- F. Malleable Iron Castings: ASTM A 47, Grade 32510.
- G. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- H. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers and shims as required, hot-dip galvanized per ASTM A 153.
- I. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

2.02 GROUT AND ANCHORING CEMENT:

- A. Non-Shrink, Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with CE CRD-C 621. Provide grout specifically recommended by manufacturer for exterior application of type specified in this section.

2.03 FASTENERS:

- A. General: Provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Select fasteners for the type, grade and class required.
- B. Steel Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

- D. Eyebolts: ASTM A 489.
 - E. Lag Bolts: ASME B18.2.1.
 - F. Machine Screws: ASME B18.6.3.
 - G. Wood Screws: Flat head, ASME B18.6.1.
 - H. Plain Washers: Round, ASME B18.22.1.
 - I. Drilled-In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion), Type I (internally threaded tubular expansion anchor), and machine bolts complying with FS FF-B-575, Grade 5.
 - J. Lock Washers: Helical, spring type, ASME B18.21.1.
- 2.04 PAINT:
- A. Shop Primer for Ferrous Metal: Manufacturer's or fabricators standard fast-curing, lead-free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure complying with performance requirements of FS TT-P-86.
 - B. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94% zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint-20.
- 2.05 FABRICATION, GENERAL:
- A. Form metal fabrications from materials of size, thickness, and shapes indicated, but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of work.
 - B. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
 - C. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication and installation of installed metal assemblies to prevent buckling, opening of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metal due to both solar heat gain and night time sky heat loss.
 - 1. Temperature Change (Range): 50°F.
 - D. Shear and punch metals cleanly and accurately. Remove burrs.
 - E. Ease exposed edges to a radius of approximately 1/32", unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - F. Remove sharp or rough areas on exposed traffic surfaces.
 - G. Weld corners and seams continuously, complying with AWS recommendations and the following:

1. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
 2. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 3. Obtain fusion without undercut or overlap.
 4. Remove welding flux immediately.
- H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat head (countersunk) screws or bolts. Locate joints where least conspicuous.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- J. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- K. Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware screws and similar items.
- L. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- 2.06 MISCELLANEOUS FRAMING AND SUPPORTS:
- A. General: Provide steel framing and supports for applications indicated or which is not a part of structural steel framework as required to complete work.
- B. Fabricate units to sizes, shapes and profiles indicated or, if not shown, of required dimensions to receive adjacent other work to be retained by framing and supports. Fabricate from structural steel shapes, plates and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers and similar items.
1. Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.
 - a. Except as otherwise indicated, space anchors 24" o.c. and provide minimum anchor units in the form of steel straps 1-1/4" wide x 1/4" x 1/8" long.
- C. Galvanize miscellaneous framing and supports in the following locations:
1. Exterior locations.
- 2.07 MISCELLANEOUS STEEL TRIM:
- A. Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.

B. Galvanize miscellaneous framing and supports in the following locations:

1. Exterior locations.

2.08 STEEL PIPE RAILINGS AND HANDRAILS:

A. General: Fabricate pipe railings and handrails to comply with requirements indicated for design, dimensions, details, finishes, and member sizes, including wall thickness of pipe, post spacings, and anchorage, but not less than that required to support structural loads.

B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless as otherwise indicated.

1. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.

C. Form changes in direction of railing members as follows:

1. By insertion of prefabricated elbow fittings.
2. By radius bends of radius indicated.
3. By mitering at elbow bends.
4. By bending.
5. By any method indicated above, applicable to change of direction involved.

D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking or otherwise deforming exposed surfaces of pipe.

E. Provide wall returns at ends of wall-mounted handrails, unless indicated otherwise.

F. Close exposed ends of pipe by use of prefabricated fittings.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.

H. Fillers: Provide steel sheet or plate fillers of thickness and size required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thickness. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.

I. For interior steel railings and handrails formed from steel pipe with black finish, provide non-galvanized ferrous metal fittings, brackets, fasteners, sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.09 STEEL FRAMED STAIRS:

A. General: Construct stairs to conform to sizes and arrangements indicated. Joint pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates and

other components necessary for the support of stairs and platforms and as required to anchor and contain the stairs on the supporting structure.

1. NAAMM Stair Standard: Comply with “Recommended Voluntary Minimum Standards for Fixed Metal Stairs” in NAAMM “Metal Stair Manual” for class of stair designated, except where more stringent requirements are indicated:
 - a. Architectural class, unless otherwise indicated.
 - B. Stair Framing: Fabricate stringers of structural steel channels, or plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to strings, newels, and framing members to strings and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces.
 - C. Metal Pan Risers, Subtreads and Subplatforms: Shape metal pans for risers and subtreads to conform to configuration shown. Provide thicknesses of structural steel sheet for metal pans indicated, but not less than that required, to support total design loading.
 1. Form metal pans of uncoated cold-rolled steel sheet, unless otherwise indicated.
 2. Attach risers and subtreads to stringers by means of brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting or bolting.
 - a. At Contractor’s option, provide prefabricated stair assemblies with prefilled treads consisting of prepoured reinforced concrete fill, with non-slip aggregate finish, in welded sheet metal pan, attached to installed stringers using manufacturer’s standard connection detail.
 3. Provide subplatforms of configuration and construction indicated. If not indicated, of same metal as risers and subtreads, in thicknesses required to support design loading. Attach subplatform to platform framing members with welds.
 - D. Stair Railings and Handrails: Comply with applicable requirements specified elsewhere in this section for steel pipe railings and handrails, and as follows:
 1. Fabricate newels of steel tubing and provide newel caps of gray-iron castings, as shown.
 2. Railings may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
 3. Connect railing posts to stair framing by direct welding, unless otherwise indicated.
- 2.10 PIPE BOLLARDS:
- A. Fabricate pipe bollards from Schedule 40 steel pipe.
- 2.11 FINISHES, GENERAL:
- A. Comply with NAAMM “Metal Finishes Manual” for recommendations relative to application and designations of finishes.
 - B. Finish metal fabrications after assembly.

2.12 STEEL AND IRON FINISHES:

- A. Galvanizing: For those exposed steel items indicated for galvanizing, provide a zinc coating by the hot-dip process for all field weld and steel exposed to weather as follows:
 - 1. ASTM A 153 for galvanizing iron and steel hardware.
 - 2. ASTM A 123 for galvanizing both fabricated and un-fabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 1/8" thick and heavier.
 - 3. ASTM A 386 for galvanizing assembled steel products.
 - a. Galvanized exposed surfaces will receive shop coat of paint and shall be chemically treated to produce a bond for the paint with exception of nuts and bolts. Galvanize items after fabrication and shop welding.
- B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP6 "Commercial Blast Cleaning".
- C. Shop priming: Apply shop primer to uncoated surfaces of metal fabrications. Comply with requirements of SSPC-PA1 "Shop, Field and Maintenance Painting of Steel" for shop painting.
 - 1. Stripe paint all edges, corners, crevices, bolts, welds, and sharp edges.

2.13 ROUGH HARDWARE:

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 sections.
- B. Fabricate items of sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts, which bear on wood structural connections; elsewhere, furnish steel washers.

PART 3 - EXECUTION:

3.01 PREPARATION:

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.02 INSTALLATION, GENERAL:

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including threaded fasteners

for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

- B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment and elevation; with edges and surfaces level, plumb, true and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.
- D. Fit exposed connections accurately together to form tight hairline joints. Weld connections that are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations.
- E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of weld surface matches those adjacent.

3.03 INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS:

- A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
 - 1. Anchor posts in concrete by means pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with non-shrink, non-metallic grout, mixed and placed to comply with grout manufacturer's directions.
 - a. Non-shrink, non-metallic grout.
 - b. Cover anchorage joint with a round steel flange attached to posts as follows:
 - 1) Welded to post after placement of anchoring material.
- B. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and steel supporting members.

- C. Anchor rail ends to steel with steel oval or round flanges welded to rail ends and structural steel members, unless otherwise indicated.
 - D. Secure handrails to wall with brackets and end fittings. Provide bracket with not less than 2-1/4" clearance from inside face of handrail and finished wall surface. Locate brackets as indicated, or if not indicated, at spacing required for design loading. Secure wall brackets and wall return fittings to building construction as follows:
 - 1. Use type of bracket with pre-drilled hole for exposed bolt anchorage.
 - 2. For concrete and solid masonry anchorage, use drilled-in expansion shield and either concealed hanger bolt or exposed lag bolt, as applicable.
 - 3. For steel framed gypsum board assemblies, fasten directly to steel framing or concealed anchors using self-tapping screws of size and type required to support structural loads.
- 3.04 INSTALLATION OF PIPE BOLLARDS:
- A. Anchor pipe bollards in concrete as indicated on the Drawings.
- 3.05 ADJUSTING AND CLEANING:
- A. Touch-up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas for the shop paint on miscellaneous metal is specified in Division 9 Section "Painting" of these specifications.
 - B. For galvanized surfaces, clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 05 50 10

ALUMINUM METAL FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Section includes the fabrication and erection of structural and miscellaneous metal fabrications not specifically included in other Sections but are required by the contract drawings and documents.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 05 40 00 Cold Formed Metal Framing
 - 2. Section 09 91 00 - Painting

1.03 REFERENCES

- A. American Institute of Steel Construction Publications
 - 1. Manual of Steel Construction
 - 2. Code of Standard Practice for Steel Buildings and Bridges
 - 3. Specification for Structural Steel Buildings
- B. ASTM International:
 - 1. ASTM A36/A36M, Specification for Carbon Structural Steel
 - 2. ASTM A48, Specification for Gray Iron Castings.
 - 3. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 4. ASTM A108, Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
 - 5. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 6. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
 - 8. ASTM A320/A320M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.

9. ASTM A325 Specifications for High-Strength Steel Bolts for Structural Steel Joints. Including Suitable Nuts and Bolts and Washers
 10. ASTM A384/A384M-02 Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
 11. ASTM A490 Specifications for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints.
 12. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 13. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 14. ASTM A793, Specification for Rolled Floor Plate, Stainless Steel
 15. ASTM A992/A992M, Specification for Structural Steel Shapes
 16. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 17. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
 18. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 19. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 20. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
 21. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate
- C. AWS (American Welding Society)
1. AWS A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination
 2. AWS D1.1/D1.1M, Structural Welding Code – Steel.
 3. AWS D1.2/D1.2M, Structural Welding Code – Aluminum
 4. AWS D1.6, Structural Welding Code – Stainless Steel
- D. NAAMM (National Association of Architectural Metal Manufacturers)
1. NAAMM, Metal Finishes Manual
- E. NSF (National Sanitation Foundation)
1. NSF 61, Drinking Water System Components – Health Effects
- 1.04 SUBMITTALS
- A. SHOP DRAWINGS

1. Submit shop drawings and product data showing layouts, details, material of construction, member size and type, and anchorage.
 - a. All dimensions for checking of structural steel details shall be shown on the drawings.
 - b. Drawings shall include all shop and erection details including cuts, copes, connections, hole, bolts and welds.
 - c. For bolted, the type, size and length of bolts including washers shall be shown.
 - d. All welds, both shop and field, shall be indicated by standard welding symbols as noted by AWS D1.1. Drawings shall show the size, length and type of each weld

B. ERECTION PLANS

1. Submit erection plans covering all structural steel and related items. The procedure shall include the sequence of erection with temporary staying and bracing.

C. PRODUCT DATA:

1. Manufacturer's catalog and product data sheets on manufactured items.
2. Mill test reports on steel, stainless steel, or aluminum products showing physical and chemical properties.
3. Ladder and Ships stairs to be provided by Precision Ladders, LLC, Morristown, TN or equal.

D. SAMPLES:

1. When requested by the Engineer, provide samples of aluminum grating and other metal products.

E. SUBSTITUTIONS OF SECTIONS:

1. Substitutions of sections or modifications of details, or both, and the reasons for such substitutions or modifications shall be submitted with the shop drawings for approval. Approved substitutions, modifications, and/or changes in related portions of the work shall be coordinated by the Contractor and shall be accomplished at no additional cost to the Owner

1.05 QUALITY ASSURANCE

1. Contactor shall field measure and verify all dimensions prior to fabrication.
2. Design connections note detailed in the drawings under the supervision of a Professional Engineer.
3. Fabricator:
 - a. Fabrication Shop and Erector shall have fabricated and erected projects of similar size and complexity for at least ten years.
4. Welding:

- a. Shop and field welders and welding operators shall be qualified by an independent laboratory using test procedures covered in AWS D1.1 and shall have been employed as a Welder/Welding Operator using the positions for which he/she is qualified during the previous 90 days. The Contractor shall provide the Engineer and laboratory inspector with the (a) names of Welders and/or Welding Operators to be employed in the shop and field, (b) certification of the position, (c) date of the last qualification test and (d) the name of the qualifying laboratory.
 - b. All welders employed in the field on the erection of the steel work shall be qualified for the most difficult welding position during field erection.
 - c. The Contractor shall require any welder to retake the test, when, in the opinion of the Engineer, the work of the welder creates a reasonable doubt as to the proficiency of the welder. Recertification of the welder shall be made to the Engineer only after the welder had taken and passed the specified test. The Engineer may require radiographic or ultrasonic testing or may require coupons to be cut from any location in any joint for testing.
 - d. All Section of welds found defective shall be chipped or cut out to base metal and rewelded before proceeding with the work.
 - e. Costs of all qualifications, tests and retests shall be borne by the Contractor
5. Responsibility for Errors:
- a. The Contractor shall be responsible for all errors of detailing, fabrication and for the correct fitting of the structural members. The Contractor shall make all measurements in the field to verify or supplement dimensions shown on the Drawings and shall assume responsibility for fitting new work to existing work.
6. Templates
- a. Templates with instructions for the setting of anchors, anchor bolts and bearing plates shall be furnished by the Fabricator to the job. The Contractor shall ascertain that the items are set during the progress of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver items to be embedded in adequate time to prevent delay in work.
- B. Deliver items with mark or identification numbers as noted on the approved shop drawings.
- C. Store materials off the ground and protected from damage.
- D. Protect painting, galvanizing, and other coatings from damage.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Aluminum:

1. Aluminum shall be of the following alloys:

a. Sheet or plate	6061-T6
b. Structural or rolled shapes	6061-T6
c. Extruded shapes	6061-T6
d. Tubing or pipe	6061-T6 or 6063-T6
e. Nuts and bolts	2024-T4 with #205 aluminum finish

B. Steel

a. Angles, Plates, and Bars	ASTM A36
b. W-Shapes & WT-Shapes	ASTM A992
c. Channels and S-Shapes	ASTM A572, Grade 50
d. Hollow Structural Sections	ASTM A500, Grade B
e. Steel Pipe	ASTM A53, Grade B

C. Stainless Steel:

1. Unless otherwise specified, all fabricated work indicated on the Drawings and/or specified to be stainless steel shall be Type 316, in accordance with ASTM A-276 as amended to date
- | | |
|--------------------------------|-----------------------|
| a. Sheet or plate | Type 304L or Type 316 |
| b. Submerged or intermittently | Type 316 |
| c. Non-submerged | Type 304L |

D. Finishes

1. Surface Preparation and Shop Priming shall be in accordance with the requirements of Section 09 91 00, Painting. Preparation and priming system shall be appropriate for the location and environment of installation.
2. Galvanizing of steel shall comply with ASTM A123

2.02 PRODUCTS

A. Bolts, Nuts, and Screws:

- a. Steel bolts and nuts for jointing miscellaneous steel shall conform to ASTM A-325 or A-490 and shall be American National Standard dimensions.

- b. Expansion bolts must be used, they shall be Rawl, National, or equal.
 - c. Anchor bolts and expansion bolts shall be Type 302, 304, or 316 stainless steel.
 - d. Steel and aluminum weir plates, aluminum railing, miscellaneous aluminum, galvanized steel and stainless steel jointing shall be fastened with Type 302 or 304 stainless steel bolts, nuts, and screws as required
2. Nosings for Concrete Treads
- a. Nosings shall be provided for all concrete steps, interior and exterior.
 - b. Nosings shall be 3-inch in width
 - c. Acceptable manufacturers are Wooster Type 101 Alumogrit or American Abrasive Metal Company Style A or equal abrasive safety treads.
3. Aluminum Grating and Treads:
- a. Aluminum grating shall be fabricated of I-shaped bars, alloy 6063-T6, with swaged cross bars spaced on 4" centers. Bearing bars shall be spaced on 1-3/16" centers. Top surface of bearing bars shall be striated to provide non-slip surface.
 - b. Grating shall be designed to support a uniform load of 200 pounds per square foot with a maximum deflection of 1/4". The maximum fiber stress shall not exceed that which is allowed by the Aluminum Association.
 - c. Minimum grating thickness shall be 1 1/2"
 - d. Standard installation clearances and tolerances shall conform to the requirements of the current Metal Bar Grating Manual published by the National Association of Architectural Metal Manufacturers.
 - e. Aluminum frames embedded in concrete shall incorporate a recess under the horizontal bearing leg to receive the hold down fasteners.
 - f. Install aluminum clamps or clips to anchor the grating securely to the supports. A minimum of 4 fasteners shall be provided, unless otherwise noted on the drawings.
 - g. Cutouts for circular obstructions are to be at least 2" larger in diameter than the obstruction. Cutouts for all piping 2" in diameter or less shall be made in the field.
 - h. Weld end plates to all bearing bars and band all cutouts. Exposed welds and welding beads on the exposed top surface of the grating and/or end plates and bands will not be acceptable.
 - i. Seat angles in concrete shall be 1/4-inch thick aluminum angles of a size which will properly accommodate the depth of the grating bars.
 - j. Aluminum shelf angles shall be anchored to the concrete using stainless steel wedge anchors.
 - k. Aluminum stair treads shall be I-bar grating type with an extruded aluminum corrugated nosing.

- l. All aluminum surfaces in contact with concrete or dissimilar metals shall be coated with bituminous paint.
4. Aluminum Access Hatches:
 - a. Provide single leaf or double leaf access frames and covers as indicated on the drawings.
 - b. Frames shall be ¼- in thick one-piece, mill finish, extruded aluminum, incorporating a continuous concrete anchor.
 - c. Bituminous coating shall be applied to the frame exterior where it will come in contact with concrete.
 - d. Door panel(s) shall be ¼-in. aluminum diamond plate, reinforced to withstand a 300 lb/ft² live load with a maximum deflection of 1/150th of the span.
 - e. Door(s) shall open to 90 degrees and automatically lock with T-316 stainless steel hold-open arm(s) with aluminum release handle(s). For ease of operation the hold-open arm shall incorporate enclosed stainless steel compression spring assist.
 - f. Door(s) shall close flush with the frame and rest on a built-in neoprene cushion/gasket.
 - g. Hinges and all fastening hardware shall be T-316 stainless steel.
 - h. Unit shall lock with a stainless-steel slam lock and removable key.
 - i. Provide a 1-1/2" (38mm) drain coupling located in the right front corner of the channel frame unless noted otherwise on the drawings. For potable water structures, contractor shall pipe frame drain outside of structure.
 - j. Unit shall carry a lifetime guarantee against defects in material and/or workmanship.
 - k. Hatches located over pump wet wells and other similar structures with depths greater than 8 feet, or over water or other liquid more than 24" in depth shall be equipped with hinged safety grate.
 5. Aluminum Pipe Railing:
 - a. Guardrails and Handrails shall be the product of a company normally engaged in the manufacture of pipe railing.
 - b. Railings shall be shop-assembled in lengths not to exceed 24 feet for field erection.
 - c. The handrail shall be made of pipes joined together with component fittings. Components that are pop-riveted or glued at the joints will not be acceptable. All components must be mechanically fastened with stainless steel hardware.
 - d. Railings shall be 1 1/2" Schedule 40 aluminum pipe alloy 6105-T5, ASTM-B-429 or ASTM-B- 221. Post shall be 1 1/2" Schedule 80 aluminum pipe of the same alloy. Post spacing shall be a maximum of 6'-0"
 - e. Guardrails/handrails shall be designed in accordance with the latest edition of the International Building Code (IBC).

- f. Guardrails and Handrails shall be designed to withstand a 200lb concentrated load applied in any direction and at any point on the top rail. Guardrails and Handrails shall also be designed to withstand a uniform load of 50 lb/ft applied horizontally to the top rail. Uniform loads are not to be applied simultaneously with the concentrated loads
 - g. Intermediate railings shall be designed to withstand a horizontally applied normal load of 50lb on an area not to exceed one square foot including openings and spaces between rails.
 - h. Intermediate railings shall be provided such that a 21-inch diameter sphere cannot pass through any opening
 - i. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations (OSHA 1910.23). The top surface of the top railing shall be smooth and shall not be interrupted by projected fittings
 - j. The mid-rail at a corner return shall be able to withstand a 200lb load without loosening. The manufacturer is to determine this dimension for their system and provide physical tests from a laboratory to confirm compliance.
 - k. Openings in the railing shall be guarded by a self-closing gate (OSHA 1910.23). Safety chains shall not be used unless specifically shown on the drawings.
 - l. Concrete anchors shall be stainless steel type 303 or 304 wedge anchors and shall be furnished by the handrail manufacturer. The anchor design shall include the appropriate reduction factors for spacing and edge distances in accordance with the manufacturers' published data.
 - m. Toeboard shall conform to OSHA standards. Toeboard shall be a minimum of 4" high and shall be an extrusion that attaches to the posts with clamps that will allow for expansion and contraction between posts. Toeboards shall be set 1/4" above the walking surface. Toeboards shall be provided on handrails as required by OSHA and/or as shown on drawings. Toeboards shall be shipped in stock lengths for field installation
 - n. A self-closing gate shall guard openings in the railing (OSHA 1910.23). Safety chains shall not be used unless specifically shown on the drawing.
 - o. Welding shall be by inert gas shielded arc method with all welds ground smooth.
 - p. Finish shall be Aluminum Association M10-C22-A41 (215-R1)
 - q. Aluminum surfaces in contact with concrete, grout or dissimilar metals will be protected with a coat of bituminous paint, Mylar isolators or other approved material.
6. Aluminum Gates and Frames:
- a. Stop Gate Guides are to be extruded aluminum, alloy 6063-T6 or 6061-T6. If required, the stop gate frames shall incorporate an anti-friction UHMW insert to reduce the coefficient of friction to 0.2 or less.
 - b. Stop Gate Disc shall be a minimum of .25" thick aluminum plate, alloy 6061-T6. The disc shall incorporate a lift handle for hand operation. The disc shall be stiffened as required to meet the loading requirements of the intended application with a minimum of deflection. Design calculations shall be furnished upon request.

- c. Surfaces in contact with concrete shall be protected with a shop coat of bitumastic paint

B. ALUMINUM SHIPS STAIR:

1. Aluminum Ships Stair and Components: Stair, mounting brackets and handrails on both sides.
 - a. Model: SL-168 Aluminum Ships Stair as manufactured by Precision Ladders, LLC.
 - b. Capacity: Unit shall support a 1,000 lb (454 kg) total load without failure.
 - c. Degree of Incline: 60 to 70 degrees.
 - d. Performance Standard: Units designed and manufactured to meet or exceed OSHA 1910.25.
2. Components:
 - a. Stair Stringer: 5 inch by 2 inch by 3/16 inch (127 mm by 51 mm by 5 mm) extruded 6005-T5 aluminum channel.
 - b. Stair Treads: 5-3/16 inch by 1-1/8 inch by 1/8 inch (131 mm by 29 mm by 3 mm) extruded 6005-T5 aluminum with serrated slip resistance surface standard. 1-1/4 inch by 1-1/4 by 1-1/4 inch angle welded to underside of treads. Treads shall be welded and bolted to stringer with 1/4" stainless steel bolts.
 - c. Stair Mounting Brackets:
 - 1) Floor Brackets: 2 inch by 3 inch by 1/4 inch (51 mm by 76 mm by 6 mm) aluminum angle.
 - 2) Top Bracket: 4-3/4 inch by 5 inch by 1/4 inch (121 mm by 127 mm by 6 mm) aluminum angle.
 - d. Handrails: 1-1/4 inches (32 mm) Schedule 40, 6005-T5 aluminum pipe provided with internal aluminum fittings.
 - e. Finishes:
 - 1) Standard: Mill finish on aluminum stair components.
 - 2) Optional Finishes
 - a) Powder Coated
 - b) Clear Anodized
3. Options
 - a. Tread material: bar grating and various types of formed plate.
 - b. Extend-A-Rail, ladder safety post attached to one side of stair to assist the climber in entering or exiting a hatch.

PART 3 - EXECUTION

3.01 FABRICATION

- A. Fabrication and Erection of Structural Steel for Buildings: Unless otherwise indicated on the drawings or in the Specifications for the design, the publication, Fabrication and Erection of Structural Steel for Buildings of the American Institute of Steel Construction, hereafter designated AISC, shall govern structural steel work.
- B. Fabricate items per the contract drawings and approved shop drawings.
- C. Provide sufficient anchors to properly fasten work.
- D. Provide in largest practical sections for delivery and installation.
- E. Welding shall comply with AWS D1.1. Welds shall be ground smooth unless noted otherwise.
- F. Factory coat or prime where required. Coat aluminum surfaces in contact with concrete or dissimilar metals with bituminous paint.

3.02 EXAMINATION

- A. Inspect all material upon delivery for damage. Damaged items shall be replaced at no cost to the owner.

3.03 INSTALLATION

- A. General Requirements:
 - 1. Install miscellaneous metal products in accordance with the manufacturer's instructions, approved shop drawings, and contract documents.
 - 2. Install plumb, level, and square and free from distortion or defects.
 - 3. Provide temporary bracing or supports to maintain alignment during installation.
 - 4. Field welding shall be performed in accordance with AWS D1.1
 - 5. Field trimming, cutting, or other similar modification shall require prior approval from the Engineer.
 - 6. Coat aluminum surfaces in contact with concrete or dissimilar metals with bituminous paint.
 - 7. Paint all steel products in accordance with Section 09 91 00 after installation.
- B. Stair Nosing:
 - 1. Provide in all concrete stair treads and top stair landings unless noted otherwise on the drawings.
 - 2. Install flush with the finished surface.
- C. Aluminum Grating and Treads:
 - 1. Install frames and supports such that the grating surface is flush with the walking surface.

2. Install embed frames such that anchoring systems are not in direct contact with steel reinforcing bars.
3. Install grating with direction of bearing bars perpendicular to the dominant direction of travel.

D. Pipe Railing

1. Install post and rails plumb and level and aligned within 1/8" in 12'
2. Field joints shall be made with a splice-lock connector to provide a secure permanent connection.
3. Openings in railing shall be protected by aluminum self-closing gates or 1/4" stainless steel safety chains, including stainless steel hardware, as indicated on the drawings.
4. Remove projections to provide a smooth surface along the top rail.
5. Expansion Joints
 - a. Install expansion joints at a maximum interval of 50' on center.
 - b. Locate expansion joints with 12" of post.
 - c. Provide expansion joint at location of structural expansion joints
6. Mounting:
 - a. Post bases shall be cored, baseplate, or side-mount plate as indicated on the drawings.
 - 1) Cored Bases
 - a) Anchor with epoxy grout as recommended by the railing manufacturer.
 - b) Drill 3/16" weep hole near the top of grout in each post
 - c) Adjust layout of reinforcing steel, with Engineers approval, to prevent cutting of rebar during base coring.
 - 2) Base and Side-Mount Plates:
 - a) Mounting plates shall be installed with minimal disturbance to the reinforcing steel.
 - b) Mounting plates shall be secured with stainless steel hardware of the size recommended by the railing manufacturer.
 - c) Post shall be fixed with stainless steel set screws or other approved methods.
 - b. Use of shims, wedges, grout or other similar methods for post alignment will not be permitted without prior approval from the Engineer.
7. Toe Board
 - a. Provide at all handrails unless noted otherwise on the drawings.

- b. Cut and secure to handrail post
- c. Bottom of toe-board should be placed approximately 1/4" above the walking surface.
- d. Provide expansion joints to match those of the handrails.

3.04 INSPECTION AND TESTING

- A. Inspections and tests shall be performed by an independent laboratory complying with ASTM E-329. The testing laboratory shall be directed by the Engineer. All material to be furnished shall be subject to inspections and tests in the shop and field.
- B. Shop inspections and tests shall include fit-up, preparation of surfaces and welding.
- C. Field inspections and tests shall include fit-up, preparations of surfaces, welding and bolting.
- D. Reports of shop and field inspections and testing shall be made by the laboratory on a weekly basis. One copy of each shop and field inspection report shall be submitted directly to each of the following: Engineer, Resident Engineer, Inspector, Contractor, Fabricator and Erector.

3.05 FIELD QUALITY CONTROL

- A. Check for excessive sway, vibration or movement. Brace or anchor if directed by Engineer.
- B. Remove burrs and other surface irregularities.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL:

1.01 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.

1.02 SUMMARY:

- A. Types of work in this section include rough carpentry for:
 - 1. Framing with dimensional lumber.
 - 2. Wood furring, grounds, nailers and blocking.
 - 3. Fasteners.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 03 3000 – Cast-in-Place Concrete.
 - 2. Section 04 0519 – Masonry Anchorage & Reinforcing.
 - 3. Section 04 0523 – Masonry Accessories.
 - 4. Section 04 2000 – Unit Masonry Assemblies.
 - 5. Section 04 7200 – Cast Stone Masonry.
 - 6. Division 5 – Metals.
 - 7. Division 6 – Woods & Plastics.
 - 8. Section 07 1113 – Bituminous Dampproofing.
 - 9. Section 07 2100 – Thermal Insulation.
 - 10. Section 07 6200 – Sheet Metal Flashing & Trim.
 - 11. Section 07 6500 – Flexible Flashing.
 - 12. Section 07 7233 – Roof Hatches.
 - 13. Section 08 1113 – Hollow Metal Doors & Frames.
 - 14. Section 08 3113 – Access Doors & Panels.
 - 15. Section 08 4113 – Aluminum-Framed Entrances & Storefronts.
 - 16. Section 09 2000 – Gypsum Board.

17. Section 09 2216 – Non-Structural Metal Framing.
18. Section 09 9100 – Paints & Coatings.
19. Section 10 2113 – Toilet Compartments.
20. Section 10 2613 – Corner Guards.
21. Section 10 2800 – Toilet & Bath Accessories.
22. Section 10 2813 – Mirror Units.
23. Section 10 4416 – Fire Protection Specialties.
24. Section 10 7500 – Flagpoles.
25. Section 12 2413 – Roller Window Shades.
26. Division 22 – Plumbing.
27. Division 23 – Mechanical.
28. Division 26 – Electrical.
29. Division 27 – Communications.
30. Division 28 – Electronic Safety and Security.

1.03 DEFINITIONS:

- A. Rough carpentry includes carpentry work not specified as part of other Sections and generally not exposed, unless otherwise specified.

1.04 REFERENCES:

- A. American Forest and Paper Association (AFPA)
 1. Manual for Wood Frame Construction
- B. Engineered Wood Association
 1. Form E30 Engineered Wood Design/Construction Guide
- C. American Society of Mechanical Engineers (ASME)
 1. B18.2.1 Square and Hex Bolts and Screws - Inch Series
 2. B18.6.1 Wood Screws (Inch Series)
- D. American Society for Testing and Materials (ASTM)
 1. A153 Specification for Zinc -Coating (Hot-Dip of Iron and Steel Hardware)
 2. A307 Specification for Carbon Steel Bolts and Studs, 60,000 PSI TensileStrength
 3. A563 Specification for Carbon and Alloy Steel Nuts

4. A653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 5. D245 Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber
 6. D2555 Test Method for Establishing Clear Wood Strength Values
- E. American Wood Preservers Association (AWPA)
1. C2 Lumber, Pressure Treatment
 2. C9 Plywood, Pressure Treatment
 3. C20 Structural Lumber, Fire-Retardant Pressure Treatment
 4. C27 Plywood, Fire-Retardant Pressure Treatment
 5. M4 Standard for the Care of Preservative-Treated Wood Products
- F. Federal Specification (FS)
1. FF-N-105B Nails, Brads, Staples, and Spikes: Wire, Cut and Wrought
- G. International Conference of Building Officials (ICBO)
1. International Building Code (IBC) Chapter 23, Wood
- H. South Coast Air Quality Management District (SCAQMD)
1. Rule #1168 Adhesive and Sealant Applications
- I. U.S. Department of Commerce, National Institute of Standards and Technology
1. PS 1 US Product Standard for Construction and Industrial Plywood
 2. PS 2 Performance Standard for Wood-Based Structural-Use Panels
 3. PS 20 American Softwood Lumber Standard (ASLS)
- 1.05 SUBMITTALS:
- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - B. Product Data: Submit manufacturer's product data for each product specified.
 - C. Material certificates for dimensional lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use as well as design values approved by the Board of Review of American Lumber Standards Committee.
 - D.

- E. Wood treatment data as follows including chemical treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material.
 - 1. For each type of preservative treated wood product include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained and compliance with applicable standards.
 - 2. For fire-retardant-treated wood products, include certification by treating plant that treated material complies with specified standard and other requirements.
 - 3. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-retardant wood products with requirements indicated.
 - 4. Warranty of chemical treatment manufacturer for each type of treatment.
 - F. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction evidencing compliance of the following wood products with specified requirements and building code in effect for Project.
 - 1. Power driven fasteners.
 - 2. Fire-retardant-treated wood.
- 1.06 QUALITY ASSURANCE:
- A. Single-Source Responsibility for Fire-Retardant Treated Wood: Obtain each type of fire-retardant-treated wood products from one source for both treatment and fire-retardant formulation
 - B. Testing Laboratory Qualifications: To qualify for acceptance, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying the progress of the Work.
 - C. All carpentry work shall be done by skilled personnel and shall be installed plumb and true.
 - D. Product standards and grading rules of the various associations under whose rules the lumber product is produced shall apply to all wood materials furnished under this section.
 - E. All lumber and plywood shall be identified by grade marks.
 - F. Preservative treated lumber shall meet current specified standards of the American Wood Preservers Association (AWPA) for "above ground usage".
- 1.07 DELIVERY, STORAGE AND HANDLING:
- A. Delivery and Storage: Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber as well as plywood and other panels; provide air circulation within stacks and under temporary covering including polyethylene and similar materials.
 - B. Immediately upon delivery to job site, place materials in area protected from weather.
 - C. Store materials a minimum of 6 inches above ground on framework or blocking and cover with protective waterproofing covering providing for adequate air circulation and ventilation.

- D. Do not store seasoned materials in wet or damp locations.
- E. Protect sheet materials from corners breaking and damaging surfaces.

1.08 JOB CONDITIONS:

- A. Coordination: Fit carpentry to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

PART 2 - PRODUCTS:

2.01 LUMBER, GENERAL:

- A. Lumber Standards: Manufacture lumber to comply with PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review. Lumber design values are to comply with ASTM D245 and ASTM D2555.
- B. Inspection Agencies: Inspection agencies and the abbreviations used to reference them with lumber grades and species include the following:
 - 1. SPIB: Southern Pine Inspection Bureau.
 - a. Standard Grading Rules for Southern Pine Lumber.
- C. Grade Stamps: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing and mill.
- D. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 1. Provide dressed lumber, surfaced four sides (S4S), unless otherwise indicated.
 - 2. Provide dry lumber with 19% maximum moisture content at time of dressing and shipment for sizes 2" or less in nominal thickness, unless otherwise indicated.

2.02 DIMENSIONAL LUMBER:

- A. General: If not indicated on contract documents, all dimension lumber shall be Southern Yellow Pine (SYP) No. 2 or better. Lumber shall comply with ALSC National Grading Rule (NGR) provisions of inspection agency applicable to species.

2.03 MISCELLANEOUS LUMBER:

- A. General: Provide lumber for support or attachment of other construction including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping, and similar members.

- B. Fabricate miscellaneous lumber from dimension lumber of sizes indicated and into shapes shown.
- C. Moisture content: 19% maximum for lumber items not specified to receive wood preservative treatment.
- D. Grade: "Standard" grade light-framing-size lumber of any species or board-size lumber as required. "No. 2 Common" or "Standard" grade boards per WCLIB or WWPA rules or "No. 2 Boards", per SPIB rules.

2.04 FASTENERS:

- A. General: Provide fasteners of size, type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry work is exposed to weather, in-ground contact, or in area of high relative humidity, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of AISI Type 304 stainless steel.
- B. Nails, Wire, Brads and Staples: ASTM F1667.
- C. Power Driven Fasteners: National Evaluation Report NER-272.
- D. Wood Screws: ANSI B18.6.1.
- E. Lag Bolts: ANSI B18.2.1.
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and where indicated, flat washers.
- G. Rough hardware shall be furnished, including nail screws, bolts, lag screws and similar fittings and all other hardware either mentioned in these specifications or required for the proper completion of the Work.

2.05 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS:

- A. General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWPB Standards C2 (Lumber) and C9 (Plywood). Mark each treated item with the AWPB or SPIB Quality Mark Requirements.
- B. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to a maximum moisture content respectively of 19% and 15%. Treat indicated items and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping and similar members in connection with roofing, flashing, vapor barriers and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing members less than 18 inches above grade.
 - 4. Wood floor plates installed over concrete slabs directly in contact with earth.

- C. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWP A M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.
- D. All framing lumber in contact with the weather, concrete slabs or exterior masonry walls, roof edge nailers, and miscellaneous nailers and blocking where indicated shall be preservative treated in accordance with specified standards.
- E. Provide pressure treated wood plate at slab-on-grade. Chemicals used for pressure treatment are corrosive to steel. All bolts and strap plates that come in contact with the wood plate must be coated with a material tested to provide corrosion resistance to the steel.

2.06 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS:

- A. General: Where fire-retardant-treated wood is indicated, pressure impregnate lumber and plywood with fire-retardant chemicals to comply with AWP A C20 and C27, respectively, for treatment type indicated; identify “fire-retardant-treated wood” with appropriate classification marking of Underwriters Laboratories, Inc., U.S. Testing, Timber Products Inspection, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Current Evaluation/Research Reports: Provide fire-retardant-treated wood for which a current model code evaluation/research report exists that is acceptable to authorities having jurisdiction and that evidences compliance of fire-retardant-treated wood for application indicated.
- B. Interior Type A: For interior locations use fire-retardant chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation.
 - 1. No reduction takes place in bending strength, stiffness, and fastener holding capabilities below values published by manufacturer of chemical formulation that are based on tests by a qualified independent testing laboratory of treated wood products identical to those indicated for this Project under elevated temperature and humidity conditions simulating installed conditions.
 - 2. No other form of degradation occurs due to acid hydrolysis or other causes related to manufacture and treatment.
 - 3. No corrosion of metal fasteners results from their contact with treated wood.
- C. Exterior Type: Use for exterior locations and where indicated.
- D. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.
- E. Available Products: Subject to compliance with requirements, fire-retardant-treated wood products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Interior Type A Fire-Retardant-Treated Wood:
 - a. “Flameproof LHC-HTT”, Osmose Wood Preserving Co., Inc.
 - 2. Exterior Type Fire-Retardant-Treated areas:

- a. “Exterior Fire X”, Hoover Treated Wood Products.

PART 3 - EXECUTION:

3.01 INSTALLATION, GENERAL:

- A. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- B. Set rough carpentry work to required levels and lines with members plumb and true and accurately cut and fitted.
- C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with IBC Table 2304.9.1 Fastening Schedule.
- E. Countersink nail heads on exposed carpentry work and fill holes.
- F. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required.
- G. All bolt heads and nuts bearing on wood shall have standard washers. Nuts and bolts exposed to the weather shall be zinc coated.
- H. Apply field treatment complying with AWPAC M4 to cut surfaces of preservative-treated lumber and plywood.

3.02 WOOD GROUNDS, NAILERS, BLOCKING AND SLEEPERS:

- A. Install wood grounds, nailers, blocking and sleepers where shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated. Build into masonry during installation of masonry work. Where possible, anchor to framework before concrete placement.

3.03 WOOD FURRING:

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

END OF SECTION

SECTION 06 40 23

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL:

1.01 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.

1.02 DESCRIPTION OF WORK:

- A. This Section includes the following:

- 1. Laminate-clad cabinets (plastic-covered casework).
- 2. Solid-surfacing material countertops.
- 3. Wood shelves.

- B. Related Sections:

- 1. Section 03 30 00 – Cast-In-Place Concrete.
- 2. Section 04 20 00 – Unit Masonry Assemblies.
- 3. Section 06 10 00 – Rough Carpentry.
- 4. Section 07 92 00 – Joint Sealants.
- 5. Section 09 20 00 – Gypsum Board.
- 6. Section 09 22 16 – Non-Structural Steel Framing.
- 7. Section 09 30 13 – Ceramic Tile.
- 8. Section 09 65 00 – Resilient Flooring.
- 9. Section 09 68 13 – Tile Carpeting.
- 10. Section 09 69 00 – Access Flooring.
- 11. Section 09 77 00 – Special Wall Surfacing.
- 12. Section 09 91 00 – Paints & Coatings.
- 13. Section 10 28 00 – Toilet & Bath Accessories.
- 14. Section 10 28 13 – Mirror Units.
- 15. Division 22 – Plumbing.
- 16. Division 26 – Electrical.

1.03 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Section.
- B. Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
- C. Shop drawings: Submit shop drawings showing location of each item, dimensioned plans and elevations, materials, profiles, assembly methods, joint details, fastening methods, accessories, hardware, and schedule of finishes.
- D. Samples for initial selection purposes of the following in the form of manufacturer's color charts consisting of actual units or selections of units showing full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Plastic laminates
 - 2. Solid-surfacing materials.
- E. Samples for verification purposes of the following:
 - 1. Lumber with or for transparent finish, not less than 5 inches wide by 24 long], for each species and cut, finished on 1 side and 1 edge.
 - 2. Laminate clad products, 8-1/2 inches, by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
 - 3. Solid-surfacing materials, 6 inches square.
 - 4. Exposed cabinet hardware, one unit of each type and finish.
- F. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.
- G. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Architects and Owner, and other information specified.

1.04 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Firm experience in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.
- B. Installer Qualifications: Arrange for installation of architectural woodwork by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this Project.
- C. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Protect woodwork during transit, delivery, storage and handling to prevent damage, soiling and deterioration.
- B. Do not deliver woodwork until painting, wet work, grinding and similar operations, which could damage, soil or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in areas other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.06 PROJECT CONDITIONS:

- A. Environmental Conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction periods.
- B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show record measurements on final shop drawing. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

1.07 WARRANTY:

- A. Special Project Warranty: Submit written warranties executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace custom casework with which fails in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
- B. Warranty period is three (3) years after the date of substantial completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable manufacturers for architectural woodwork:
 - 1. Members in good standing of the Architectural Woodwork Institute.
 - 2. Certified by the AWI Quality Certification Program to perform work in this Section of the AWI Grade of Work specified.

2.02 QUALITY STANDARDS:

- A. For following types of architectural woodwork, comply with indicated standards as applicable:
 - 1. Casework and Countertops: AWI Section 400.
 - 2. Shelving: AWI Section 600.
 - 3. Miscellaneous Work: AWI Section 700.

- B. Design and Construction Features: Comply with details shown for profile and construction of architectural woodwork, and where not otherwise shown, comply with applicable Quality Standards, with alternate details as Fabricator's option.
 - C. Pre-Cut Openings: Fabricate architectural woodwork with pre-cut openings, where possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutoffs and where located in countertops and similar exposures seal edges of cutouts with a water-resistant coating.
 - D. Measurements: Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawing details as required for accurate fit.
 - E. Where sequence of measuring substrates before fabrication would delay the project, proceed with fabrication (without measurements) and provide ample borders and edges to allow for subsequent scribing and trimming of woodwork for accurate fit.
- 2.03 MATERIALS:
- A. Wood Materials:
 - 1. Hardwood Lumber: Graded in accordance with AWI for Grade of Work specified plain sliced white ash, moisture content of 6-8 percent; with vertical grain, of quality suitable for transparent finish.
 - 2. Softwood Lumber Standards: Comply with PS 20 and with applicable grading rules of the respective grading and inspecting agency for the species and product indicated.
 - B. Sheet Materials:
 - 1. Hardwood Plywood: Graded in accordance with AWI for Grade of Work specified; veneer core, type of glue recommended for application;
 - a. Veneer: White Birch, plain sliced.
 - b. Grade: A, per ANSI/HPVA HP-1.
 - 2. Hardboard: Graded in accordance with AWI for Grade of Work specified, pressed wood fiber with resin binder, standard grade, ¼ inch, smooth, two sides, located as follows:
 - a. Drawer bottoms
 - b. Cabinet backs
 - C. Laminate Materials:
 - 1. Plastic Laminate: NEMA LD 3 for type, thickness, color, pattern and finish indicated for each application or if not indicated, as selected by Architect from manufacturer's standard products.
 - a. Basis-of-Design manufacturer: Formica.

- b. Plastic laminate backings are used on the reverse surface of plastic laminated components, to assist in maintaining dimensional stability by reducing moisture intrusion and subsequent warping of the core material.
 - c. Laminate Backing Sheet: NEMA LD-3 BKL backing grade, undecorated plastic laminate.
 - 2. Section 01 6000 – Product Requirements: Product selection procedures: Substitutions: Permitted.
 - D. Solid Surfacing Material: Cast, filled, acrylic; not coated, laminated or of composite construction, meeting ANSI Z124 2011.
 - 1. Basis-of-Design Product: Corian Surfaces from the DuPont Company.
 - 2. Section 01 6000 – Product Requirements: Product selection procedures: Substitutions: Permitted.
- 2.04 FABRICATION, GENERAL:
- A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.
 - B. Fabricate woodwork to dimensions, profile, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of cabinet and edges of solid wood (lumber) members less than 1 inch in nominal thickness: 1/16 inch.
 - 2. Edges of rails and similar members more than 1 inch in nominal thickness: 1/8 inch.
 - C. Complete fabrication, including assembly, finishing and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming and fitting.
 - D. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.
- 2.05 WOOD CASEWORK AND WOOD VENEER LAMINATE CASEWORK:
- A. Quality Standard: Comply with AWI Section 400 and its Division 400B “Laminate Clad Cabinets.”
 - B. Grade: Premium.
 - C. Wood species for concealed surfaces: Any closed grain hardwood at the fabricator’s option.
 - D. Provide fabricators standard low pressure plastic-laminate for finishing the interior of drawers and cabinets.

- E. Provide dust panels of ¼-inch plywood or tempered hardwood above compartments and drawers except where located directly under tops.
- 2.06 LAMINATE CLAD CABINETS (PLASTIC-COVERED CASEWORK):
- A. Quality Standard: Comply with AWI Section 400 and its Division 400B “Laminate Clad Cabinets.”
 - B. Grade: Custom.
 - C. AWI Type of Cabinet Construction: As indicated.
 - D. Laminate Cladding: High pressure decorative laminate complying with the following requirements:
 - 1. Colors, Patterns and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - a. Graphite, 837-58.
 - 2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade.
 - a. Horizontal Surfaces Other Than Tops: GP-50 (0.050-inch nominal thickness).
 - b. Postformed Surface: PF-42 (0.042-inch nominal thickness).
 - c. Vertical Surfaces: GP-50 (0.050-inch nominal thickness).
 - d. Edges: GP-50 (0.050-inch nominal thickness).
 - 3. Semi exposed Surfaces: Provide surface material indicated below:
 - a. Woodwork manufacturer’s standard low pressure laminate, unless indicated otherwise.
 - E. Provide dust panels of ¼-inch plywood or tempered hardwood above compartments and drawers, except where located directly under tops.
- 2.07 CABINET HARDWARE AND ACCESSORY MATERIALS:
- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
 - B. Hardware Standards: Comply with ANSI/BHMA A156.9 “American National Standard for Cabinet Hardware” for items indicated by reference to BHMA numbers or referenced to this standard.
 - C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA code number indicated.
 - 1. Satin Stainless Steel, Stainless Steel Base: BHMA 630.

- D. For concealed hardware provide manufacturer's standard finish that complies with product class requirements of ANSI/BHMA A156.9.

2.08 SOLID SURFACING MATERIAL COUNTERTOPS:

- A. Grade: Premium.

- B. Solid-Surfacing-Material Thickness:

- 1. Counter Tops: 1/2-inch-thick solid polymer material adhesively joined with inconspicuous seams, having edge details as detailed on the Drawings.
- 2. Cove Backsplash: Fabricate backsplashes using 1/2-inch solid polymer material. Create 1/2-inch radius cove at intersection of counters and backsplashes.

- C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

- 1. Color:
 - a. Countertops, vanities and splashes: Matterhorn, Group 2.
 - b. Window sills and aprons: Sandstone, Group 2.
- 2. Finish:
 - a. Provide surfaces with a uniform finish.
 - 1) Matte; gloss range of 5-20; unless indicated otherwise.

- D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

- 1. Fabricate tops with shop-applied edges of materials and configuration indicated.
- 2. Fabricate tops with loose backsplashes for field application.

- E. Miscellaneous materials:

- 1. Adhesive: Provide manufacturer's standard two-part adhesive kit to create inconspicuous, non-porous joints by chemical bond.
- 2. Sealant: Manufacturer's standard mildew-resistant, FDA, UL listed silicone sealant in colors matching components.
- 3. Conductive Tape: 3M® aluminum foil tape, 4 mils thick, for use with cutouts near heat sources.
- 4. Insulating Felt Tape: Manufacturer's standard for use with conductive tape in insulating solid polymer from adjacent heat source.

2.09 INTERIOR SHELVING:

- A. Quality Standard: Comply with AWI Section 600.

B. Wood Framings and Trim: Hardwood species graded and inspected by WWPA complying with the following:

1. Grade for Standard Size: Birch; B Better Select.

C. Plywood: Birch veneered plywood, A-A thickness as indicated on the drawing.

2.10 FACTORY FINISHING OF INTERIOR ARCHITECTURAL WOODWORK:

A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.

B. General: The entire finish of interior architectural woodwork is specified in the section, regardless of whether factory applied or applied after installation.

1. Factory Finishing: To the greatest extent possible, finish architectural woodwork at factory. Defer only final touch-up, cleaning and polishing until after installation.

C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

2.11 ACCESSORIES:

A. Cabinet pulls: Refer to drawings for selections.

B. Grommets: Plastic material for cutouts. Color to be black.

2.12 FASTENERS AND ANCHORS:

A. Screws: Select material, type, size and finish required for each use. Comply with FS FF-S-111 for applicable requirements.

2. For metal framing supports, provide screws as recommended by metal framing manufacturer.

B. Nails: Select material, type, size and finish required for each use. Comply with FS FF-N-105 for applicable requirements.

C.

D. Anchors: Select material, type, size and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and insert on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish insert and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

E. Concealed Joint Fasteners: Threaded Steel.

2.13 MISCELLANEOUS MATERIALS:

A. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

- B. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Contact Adhesive: 250 g/L.

PART 3 - EXECUTION:

3.01 PREPARATION:

- A. Condition woodwork to average prevailing humidity conditions in installation areas prior to installing.
- B. Pre-Installation Meeting:
 - 1. Meet at project site prior to delivery of architectural woodwork and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work.
 - 2. Include in meeting the Contractor, Architect and other Owner representatives (if any), installers of architectural woodwork, wet work such as plastering, other finishes, painting, mechanical work and electrical work, and firms or persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions.
 - 3. Proceed with woodwork installation only when everyone concerned agrees that required ambient conditions can be maintained.
- C. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.
- D. Prior to installation of architectural woodwork, examine shop-fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.02 INSTALLATION:

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.
- B. Install woodwork plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.
- C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- D. Anchor woodwork to anchors or blocking built-in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where pre-finished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

- E.
- F. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.
- G. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- H. Maintain veneer sequence matching (if any) of cabinets with transparent finish.
- I.
- J. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 3. Secure backsplashes to walls with adhesive.
 - 4. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
- K. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.
 - 3. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.03 ADJUSTMENT AND CLEANING:

- A. Repair damaged and defective woodwork wherever possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch-up factory-applied finishes to restore damaged or soiled areas.

3.04 PROTECTION:

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 07 11 13

BITUMINOUS DAMPPROOFING

PART 1 - GENERAL:

1.01 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.

1.02 DESCRIPTION OF WORK:

- A. This Section includes the following:
 - 1. Cold-applied asphalt emulsion dampproofing.
- B. Related Sections:
 - 1. Section 04 0519 – Masonry Anchorage & Reinforcing.
 - 2. Section 04 2000 – Unit Masonry Assemblies.
 - 3. Section 06 1000 – Rough Carpentry.
 - 4. Section 07 1326 – Self-Adhering Sheet Waterproofing.
 - 5. Section 07 2100 – Thermal Insulation.
 - 6. Section 07 2419 – Exterior Insulation & Finish System with Moisture Drainage.
 - 7. Section 07 6200 – Sheet Metal Flashing & Trim.
 - 8. Section 07 6500 – Flexible Flashing.
 - 9. Section 07 9200 – Joint Sealants.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data, installation instructions, and recommendations for each dampproofing material required. Include data substantiating that materials comply with specified requirements.

1.04 QUALITY ASSURANCE:

- A. Single-Source Responsibility: For each type of work, obtain primary dampproofing materials and primers from a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Installer Qualifications: A firm which has specialized for not less than five years in installation of types of dampproofing required for project and which is acceptable to manufacturer of primary materials.

1.05 PROJECT CONDITIONS:

- A. Substrate: Proceed with dampproofing work only after substrate construction and penetrating work have been completed.
- B. Weather: Proceed with dampproofing work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS:

2.01 COLD-APPLIED ASPHALT EMULSION DAMPPROOFING:

- A. Asphalt Emulsion: Manufacturer's standard asphalt and water emulsion coating compounded to penetrate substrate and build to moisture-resistant coating.
 - 1. Provide semi-fibrated type semi-mastic asbestos-free emulsion; ASTM D 1227, Type II, except containing non-asbestos fibrous reinforcement and filler materials.
- B. Acceptable Manufacturer: Subject to compliance with requirements, provide coal tar products of one of the following:
 - 1. Celotex Corporation.
 - 2. Karnak Chemical Corporation.
 - 3. Sonneborne Building Products.
 - 4. W.R. Meadows, Inc.
- C. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 MISCELLANEOUS MATERIALS:

- A. Bituminous Grout: Comply with ASTM D 147.
- B. Protection Course, Film Type: 4-mil carbonated polyethylene film.
- C. Plastic Cement: Asphalt based, complying with ASTM D 491, except provide coal tar base where specifically recommended by manufacturer of bituminous dampproofing materials.

PART 3 - EXECUTION:

3.01 PREPARATION OF SUBSTRATE:

- A. Clean substrate of projections and substances detrimental to work; comply with recommendations of prime materials manufacturer.
 - B. Fill voids, seal joints, and apply bond breakers (if any) as recommended by prime materials manufacturer, with particular attention at construction joints (if any).
 - C. Install separate flashings and corner protection stripping as recommended by prime materials manufacturer. Comply with manufacturer's recommendations.
 - D. Prime substrate as recommended by prime materials manufacturer.
 - E. Protection of Other Work: Do not allow liquid and mastic compounds to enter and clog drains and conductors. Prevent spillage and migration onto other surfaces of work, by masking or otherwise protecting adjoining work.
- 3.02 INSTALLATION GENERAL:
- A. Comply with manufacturer's instructions, except where more stringent requirements are indicated or specified, and where project conditions require extra precautions or provisions to ensure satisfactory performance of work.
- 3.03 ASPHALT EMULSION ON EXTERIOR AND INTERIOR SURFACES:
- A. Apply coat of semi-fibrated, semi-mastic, asphalt emulsion dampproofing materials, by brushing or spraying at rate of 5.0 gal. per 100 sq. ft., to produce uniform dry film thickness of not less than 30 mils.
- 3.04 INSTALLATION OF DAMPPROOF PROTECTION COURSE:
- A. General: Install protection course of type indicated over completed-and-cured dampproofing treatment. Comply with dampproofing materials manufacturer's recommendations for method of support or attachment of protection materials. Support with spot application of plastic cement where not otherwise indicated.

END OF SECTION

SECTION 07 13-26

SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections apply to this Section.

1.02 SUMMARY:

- A. This Section includes sheet membrane waterproofing systems.
- B. Types of sheet waterproofing specified in this section include the following:
 - 1. Rubberized asphalt sheet waterproofing.
- C. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 07 11 13 - Bituminous Dampproofing.
 - 3. Division 31 – Earthwork.

1.03 SYSTEM PERFORMANCE:

- A. General: Provide sheet-waterproofing products, which have been produced and installed to establish and maintain watertight continuous seals.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data and general recommendations from waterproofing materials manufacturer for types of waterproofing required. Include data substantiating that materials comply with requirements.
- C. Samples of sheet membrane waterproofing and auxiliary materials.

1.05 QUALITY ASSURANCE:

- A. Manufacturer: Obtain primary waterproofing materials of each type required from a single manufacturer, to greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.

- B. Installer: Firm with not less than 5 years of successful experience in installation of waterproofing similar to requirements for this project and which is acceptable to manufacturer of primary waterproofing materials.
 - C. Preinstallation Conference: Prior to installation of waterproofing and associated work, meet at project site with Installer of each component of associated work, inspection and testing agency representatives, and installers of work requiring coordination with waterproofing work. Review material selections and procedures to be followed in performing work. Notify Architect at least 48 hours before conducting meeting.
- 1.06 PROJECT CONDITIONS:
- A. Substrate: Proceed with work after substrate construction, openings, and penetrating work have been completed.
 - B. Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.
- 1.07 WARRANTY:
- A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace sheet membrane waterproofing that fails in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
 - 1. Warranty period is 10 years from date of Substantial Completion.

PART 2 - PRODUCTS:

2.01 RUBBERIZED ASPHALT SHEET WATERPROOFING:

- A. Self-adhering membrane of rubberized asphalt integrally bonded to polyethylene sheeting, formed into uniform flexible sheets of not less than 60 mils thick, complying with the following:
 - 1. Tensile Strength: 250 psi minimum; ASTM D 412.
 - 2. Ultimate Elongation: 300% minimum; ASTM D 412.
 - 3. Pliability Temperature: Minus 25°F (minus 32°C); ASTM D146.
 - 4. Hydrostatic Head Resistance: 150'-0" minimum.
 - 5. Water Absorption: Not more than 0.5% weight gain after 48 hours of immersion at 70°F (21°C); ASTM D 570.
- B. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Mel-Rol; W.R. Meadows, Inc.
 - 2. Bituthene; W.R. Grace & Co.

- C. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Permitted.

2.02 AUXILIARY MATERIALS:

- A. Adhesives and Joint Tape: Provide types of adhesive compound and tapes recommended by waterproofing sheet manufacturer for bonding to substrate (if required), for waterproof sealing of seams in membrane, and for waterproof sealing of joints between membrane and flashings, adjoining surfaces and projections through membrane.
- B. Primers: Provide type of concrete primer recommended by manufacturer of sheet waterproofing material for applications required.
- C. Flashing Materials: Except as otherwise indicated, provide types of flexible sheet material for flashing as recommended by waterproofing sheet manufacturer.
- D. Protection Board: Provide type of protection board as recommended by waterproofing sheet manufacturer. Include adhesives recommended by manufacturer.

PART 3 - EXECUTION:

3.01 PREPARATION:

- A. General: Comply with manufacturer's instructions for surface preparation.
- B. On vertical foundation walls, chip off projections where necessary for proper placement and adhesion of waterproofing sheet.
- C. Apply primer to concrete and masonry surfaces at rate recommended by manufacturer of primary waterproofing materials. Prime only area, which will be covered by WP membrane in same working day; re-prime areas not covered by WP membrane within 24 hours.

3.02 INSTALLATION:

- A. Comply with manufacturer's instructions for handling and installation of sheet waterproofing materials.
- B. Coordinate installation of waterproofing materials and associated work to provide complete system complying with combined recommendations of manufacturers and installers involved in work. Schedule installation to minimize period of exposure of sheet waterproofing materials.
- C. Seal at projections through membrane and seal seams. Bond to vertical surfaces and also, where shown or recommended by manufacturer, bond to horizontal surfaces.
- D. Top Edge Seal: For vertical and sloped wall membrane, finish in reglet; otherwise, finish under flashing or under masonry in joint. Caulk exposed edges with mastic or sealant.
- E. Expansion Joint: Install joint filler as recommended by manufacturer, with protruding rounded surfaces. Apply continuous 8" wide strip of membrane on joint, followed by membrane application.

- F. Coat exposed areas of sheet and flashing materials. Comply with sheet manufacturer's recommendations for application and cure of coating.
 - G. Install protection board over completed membrane, complying with manufacturer's recommendations for both waterproofing sheet and protection course materials.
 - H. Provide winter-grade (low temperature membrane) waterproofing system when the air and surface temperatures are between 20°F (-7°C) and 60°F (16°C).
- 3.03 FIELD QUALITY CONTROL:
- A. In-place Testing: Before completed membranes on horizontal surfaces are covered by protection course, or other work, test for leaks with 2" depth of water maintained for 24 hours. Repair any leaks revealed by examination of sub-structure and repeat test until no leakage is observed.
- 3.04 CLEANING:
- A. After completion, remove any masking materials and stains from exposed surfaces caused by waterproofing installation.
- 3.05 PROTECTION:
- A. Provide for protection of completed membrane during installation of other materials or processes over membrane and throughout remainder of construction period. Do not allow traffic of any type on unprotected membrane.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK:

- A. Extent of insulation work is shown on drawings and indicated by provisions of this section.
- B. Applications of insulation specified in this section include the following:

- 1. Board Insulation.
- 2. Batt and Roll Insulation.
- 3. Blanket Insulation.
- 4. Vapor Retarder.

- C. Related Sections:

- 1. Section 03 30 00 - Cast-in-Place Concrete.
- 2. Section 07 25 00 - Weather Barrier.
- 3. Section 07 26 00 - Vapor Retarder.
- 4. Section 09 20 00 - Gypsum Board.
- 5. Section 09 22 16 - Non-Structural Metal Framing.
- 6. Section 31 31 16 -Termite Control.

1.03 QUALITY ASSURANCE:

- A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by R-values they represent the rate of heat flow through a homogenous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.
- B. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.

1. Surface Burning Characteristics: ASTM E 84.
 2. Fire Resistance Ratings: ASTM E 119.
 3. Combustion Characteristics: ASTM E 136.
- C. Installers shall be qualified to perform work of this section and shall be experienced in the performance of installation operations as appropriate to the project.
- 1.04 SUBMITTALS:
- A. Product Data: Submit manufacturer's product literature and installation instructions for each type of insulation material required.
 - B. Certified Test Reports: With product data, submit copies of certified test reports showing compliance with specified performance values, including r-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings and similar properties.
- 1.05 QUALITY ASSURANCE:
- A. Manufacturer Qualifications: Manufacturer with a minimum of ten years of experience manufacturing products in this section shall provide all products listed.
 - B. Installer Qualifications: Products listed in this section shall be installed by a single organization with at least five years of experience successfully installing insulation on projects of similar type and scope as specified in this section.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
 - B. Storage: Store materials in dry locations with adequate ventilation, free from water, and in such a manner to permit easy access for inspection and handling.
 - C. Handling: Handle materials to avoid damage.
- 1.07 SEQUENCING:
- A. Coordinate with the installation of vapor retarders and air seal materials specified in Section 07 26 00 - Vapor Retarder.
 - B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.
- 1.08 PROJECT CONDITIONS:
- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

A. Acceptable Manufacturers:

1. CertainTeed.
2. Knauf Insulation.
3. Owens-Corning
4. Dow Chemical Company.
5. Guardian Building Products.

B. Section 01 60 00 - Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 APPLICATION:

A. Exterior Stud Walls: Batt type.

1. Thickness: 6.00 inches.
2. R-Value: 19.
3. Vapor Retarder: Foil Facing.

B. Above Soffits: Batt type.

1. Thickness: 6.00 inches.R-Value: 19.

C. Interior stud walls:

1. Thickness: 3.50 inches.
2. R-Value: 11.
3. Vapor Retarder: Unfaced.

D. Slab Edge: Board type.

1. Thickness: 3.00 inches.
2. R-Value: 15.

2.03 INSULATING MATERIALS:

A. General: Provide insulating materials, which comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.

1. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths, and lengths.

B. Extruded Polystyrene Board Insulation: Rigid, cellular thermal insulation with closed-cells and integral high-density skin; formed by the expansion of polystyrene base resin in an extrusion

process to comply with ASTM C 578 for Type indicated; with 5 year aged R-values of 5.4 and 5 at 40° F and 75° F, respectively; and as follows:

1. Type VII, 60 psi minimum compressive strength, 2.2 lb. /cu. ft. minimum density.
 2. Surface Burning Characteristics: Maximum flame and smoke developed values of 75 and 450, respectively.
- C. Thermal Foil Faced Exposed Batt Insulation: Thermal insulation produced by combining mineral fibers of type described below with thermo-setting resins to comply with ASTM C 665 for Type III, Class A, Category 1; foil-scrim-kraft vapor-retarder membrane on one face (with extended flange), respectively, and as follows:
1. Mineral Fiber Type: Fibers manufactured from glass.
 2. Combustion Characteristics: Passes ASTM E 136 test.
 3. Surface Burning Characteristics: Maximum flame spread and smoke developed
 4. Facing Permeance: Foil-scrim-kraft faced products shall have ratings of .02 or less (ASTM E 96).
- D. Safing insulation: Complies with ASTM C 665. Types I and III, ASTM C 612, Type IA, IB and II and ASTM C 553 and mineral fiber thermal insulation.
1. Type: Unfaced.
 - a. Fire Hazard Classification: ASTM E 84:
 - 1) Maximum Flame Spread Index; 15.
 - 2) Maximum Smoke Developed Index; 0.
 - b. Noncombustibility: ASTM E 136, passes.
 - c. Density: 6.0 pcf nominal.
 - 1) Thickness: 1-1/2 inch (38 mm).
 - 2) Thermal Resistance: R per 1 inch of thickness 4.16.
- E. Sound attenuation batts:
1. Type: Unfaced glass fiber acoustical insulation complying with ASTM C 665, Type 1.
 2. Surface burning characteristics:
 - a. Maximum flame spread: 10.
 - b. Maximum smoke developed: 10.
 3. Combustion characteristics: Passes ASTM E 136.
 4. Fire resistance ratings: Passes ASTM E 119 as part of a complete fire tested wall assembly.
 5. Dimension stability: Linear shrinkage less than 0.1%

2.04 AUXILIARY INSULATING MATERIALS:

- A. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer, and complying with requirements for fire performance characteristics.
- B. Mechanical Anchors: Type and size as recommended by insulation manufacturer for type of application and condition of substrate.
- C. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.
- D. Protection Board: Premolded semi-rigid asphalt/fiber composition board, ¼" thick, formed under heat and pressure, standard size.

PART 3 - EXECUTION:

3.01 INSPECTION AND PREPARATION:

- A. Installer shall examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified. Obtain Installer's written report listing conditions detrimental to performance of work in this section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.
- B. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

3.02 INSTALLATION, GENERAL:

- A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.
- B. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections, which interfere with placement.
- C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.03 INSTALLATION OF UNDER-SLAB INSULATION:

- A. Protect top surface of horizontal insulation (from damage during concrete work) by application of protection board.

3.04 INSTALLATION OF GENERAL BUILDING INSULATION:

- A. Install in accordance with NAIMA "Recommendations for Installation in Residential and Other Light-Frame Construction - Fiber Glass Building Insulation" and manufacturer's instructions.
- B. Surface Application: Apply insulation directly to surface with appropriate spindle or prong-type anchors.

1. Fasten anchors to steel surfaces by welding the pin to metal or by using pre-attached heads and welded through the insulation.
 2. Fasten anchors to other substrates with adhesive. Follow manufacturer's recommendations for surface preparation and adhesive pattern.
 3. Impale insulation on anchor and secure with washer.
 4. Select pin lengths to ensure tight fit. Protect pin tips where subject to human contact.
 5. See manufacturer's diagram for impaling pin pattern.
- C. Between Metal Studs, Rafters, and Joists: Friction fit insulation between framing members after cover material has been installed on one side of the cavity.
1. Faced Insulation: Tape attachment flanges to face of metal framing prior to applying interior finish.
- D. Wall Heights Over 8 Feet (2440 mm) and Ceilings: Provide supplementary support to hold insulation in place until finish surface is applied.
- E. Maintain vapor retarder integrity by tightly abutting adjacent insulation.
- F. Repair punctures or tears in vapor retarder facing by taping. Follow tape manufacturer's application recommendations.
- G. Do not leave kraft or standard foil facings exposed.
- 3.05 PROTECTION:
- A. General: Protect installed insulation and vapor retarder from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or where that is not possible, by temporary covering or enclosure.
 - B. Installer shall advise contractor of exposure hazards, including possible sources of deterioration and fire hazard.

END SECTION

SECTION 07 22 00

ROOF AND DECK INSULATION

PART 1 - GENERAL:

1.01 DESCRIPTION OF WORK:

- A. Extent of insulation work is shown on drawings and indicated by provisions of this section.
- B. Applications of insulation specified in this section include the following:
 - 1. HCFC FREE Polyiso Rigid board type roof insulation(s) for thermal protection as part of roofing assemblies.
 - 2. Cover board.
 - 3. Roofing crickets.
- C. Related Sections:
 - 1. Section 05 31 00 - Steel Deck.
 - 2. Section 06 10 00 - Rough Carpentry.
 - 3. Section 07 21 19 - Foamed-In Place Insulation.
 - 4. Section 07 26 00 - Vapor Retarders.
 - 5. Section 07 30 10 - Roofing Underlayment.
 - 6. Section 07 41 13 - Metal Roof Panels.
 - 7. Section 07 54 23 - Thermoplastic Membrane Roofing.

1.02 REFERENCES:

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Insulation Board.
 - 2. ASTM D 312 - Standard Specification for Asphalt Used in Roofing.
 - 3. ASTM E 108 - Standard Test Methods for Fire Tests of Roof Coverings.
 - 4. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. Factory Mutual (FM):
 - 1. FM 4450 - Approval Standard - Class I Insulated Steel Roof Decks.

2. FM 4470 - Approval Standard - Class I Roof Covers.
 - C. Long Term Thermal Resistance (LTTR) predicted by CAN/ULC-S770-03.
 - D. Underwriters Laboratories, Inc. (UL):
 1. UL 263 - Fire Tests of Building Construction and Materials.
 2. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.
 3. UL 1256 - Fire Test of Roof Deck Constructions.
- 1.03 DEFINITIONS:
- A. LTTR (Long Term Thermal Resistance) is defined as using techniques from ASTM C1303 or CAN/ULC-S770, the predicted R-Value that has been shown to be equivalent to the average performance of a permeably faced foam insulation product over 15 years. LTTR applies to ALL foam insulation products with blowing agents other than air, such as polyiso, extruded polystyrene and polyurethane. The new method is based on consensus standards in the US and Canada.
- 1.04 SUBMITTALS:
- A. Submit under provisions of Section 01 3300.
 - B. Product Data:
 1. Manufacturer's specifications
 2. Installation instructions for insulation board and fasteners
 3. Product Data as per ASTM 2129 – 01 Standard for Data Collection for Sustainability Assessment of Building Products
 - C. Certificates: System Manufacturer's or insulation manufacturer's certification that the insulation meets Zero ODP (Ozone Depletion Potential) and Zero GWP (Global Warming Potential) specification requirements.
 - D. Thermal Warranty: Submit sample warranty indicating conditions and limitations.
- 1.05 QUALITY ASSURANCE:
- A. Regulatory Requirements:
 1. American Society for Testing and Materials (ASTM).
 2. Factory Mutual (FM).
 3. Underwriters Laboratories Inc. (UL) Classification.
 4. IBC, BOCA, ICBO and SBCCI Sections on Foam Plastic Insulation.
- 1.06 DELIVERY, STORAGE AND HANDLING:
- A. Deliver insulation in packages labeled with material name, thermal value and product code.

- B. When stored outdoors, stack insulation on pallets above ground or roof deck and cover with tarpaulin or other suitable waterproof coverings. Slit or remove manufacturer's packaging before covering with waterproof covering.

1.07 PROJECT CONDITIONS:

- A. Comply with insurance underwriter's requirements applicable for products of this Section.
- B. Do not install insulation on roof deck when water of any type is present. Do not apply roofing materials when substrate is damp or wet.

1.08 WARRANTY:

- A. Warranty: Submit written warranty executed by manufacturer for all thermal insulation.
 - 1. Warranty period shall be twenty (20) years from date of Substantial Completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Basis of Designs: Atlas Roofing Corporation, 2000 River Edge Parkway, Suite 800, Atlanta, GA 30328. Ph. (770) 952-1442.
- B. Products of manufacturers listed below meeting indicated standard and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to approval of product list and samples:
 - 1. Dow Chemical Company.
 - 2. Guardian Building Products.
- C. Section 01 60 00 - Product Requirements: Product selection procedures: Substitutions: Permitted.
- D. Provide polyiso roof board insulation from a single manufacturer.

2.02 MATERIALS:

- A. Polyiso Roof Board Insulation: Provide products that comply with the following:
 - 1. ASTM standards specified.
 - 2. Factory Mutual (FM) approvals specified.
 - 3. Underwriters Laboratories Inc. (UL) classifications specified.
 - 4. BOCA National Building Code Section on Foam Plastic Insulation
 - 5. ICBO Uniform Building Code Section on Foam Plastic Insulation.
 - 6. SBCCI Standard Building Code Section on Foam Plastic Insulation.

- B. ACFoam-II: Closed-cell HCFC free “Green” polyisocyanurate foam core manufactured using HCFC blowing agent and integrally laminated to heavy non- asphaltic fiber-reinforced felt facers; FM 1-90 wind uplift classification; compressive strength - 20 psi.
1. ASTM C 1289, Type II, Class 1.
 2. FM Standard 4450/4470 Approval.
 3. ACFoam-II is approved for Class 1 insulated steel, wood, concrete and gypsum roof deck construction for 1-90 Windstorm Classifications. Refer to FM Approval Guide for details on specific systems.
 4. UL Standard 1256 Classification: Insulated metal deck construction assemblies - Construction #120 and #123.
 5. UL Standard 790 (ASTM E 108) Classification: Class A with most roof membrane systems. See UL Roofing Materials & Systems Directory.
 6. UL Standard 263 Fire Resistance Classification (ASTM E 119): Some classifications for fire resistance are P225, P230, P259, P508, P510, P514, P519, P701, P710, P713, P717, P718, P719, P720, P722, P723, P724, P725, P727, P728, P729, P730, P732, P801, P814, P815, P818, P819, and P828. See UL Fire Resistance Directory for updated listings.
 7. UL Standard 1897 Uplift Resistance: 120 psf, 150 psf, 165 psf, 245 psf.
- C. Tapered ACFoam-II: Closed-cell HCFC free “Green” polyisocyanurate foam core manufactured using HCFC blowing agent and integrally laminated to heavy non-asphaltic fiber-reinforced felt facers; FM 1-90 wind uplift classification; compressive strength - 20 psi.
1. ASTM C 1289, Type II, Class I.
 2. FM Standard 4450/4470 Approval: Tapered ACFoam is approved for Class 1 insulated steel, wood, concrete and gypsum roof deck construction for 1-90 Windstorm Classifications. Refer to FM Approval Guide for details on specific systems.
 3. UL Standard 1256 Classification: Insulated metal deck construction assemblies - Construction #120 and #123.
 4. UL Standard 790 (ASTM E 108) Classification: Class A with most roof membrane systems. See UL Roofing Materials & Systems Directory.
 5. UL Standard 263 Fire Resistance Classification (ASTM E 119): Some classifications for fire resistance for Tapered ACFoam are P225, P230, P259, P508, P510, P514, P701, P710, P713, P717, P718, P719, P720, P722, P723, P724, P725, P727, P728, P729, P730, P732, P801, P814, P815, P818, P819, and P828.
- D. Cover Board: High Density Polyisocyanurate Cover Board:
1. Thickness: 0.5 inch (12.7mm).
 2. R-Value: 2.5 based on ASTM tests C158 and C177.
 3. Attachment: Mechanical through fastening.

- E. System LTTR - Insulation Value: R30. System LTTR shall include cover board, rigid insulation board at roof and at/below patio panels. See details.
- F. Related Materials:
 - 1. Fasteners: Factory Mutual approved.
 - 2. Base Ply: As recommended by membrane manufacturer.
 - 3. Asphalt Bitumen: Comply with ASTM D 312, Type III (steep) or Type IV. Use only on approved board insulation types.
 - a. Provide with labels indicating flash point, softening point, finished blowing temperature, and equiviscous temperature.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine roof deck for suitability to receive insulation. Verify that substrate is dry, clean and free of foreign material that will damage insulation or impede installation.
- B. Verify that roof drains, scuppers, roof curbs, nailers, equipment supports, vents and other roof accessories are secured properly and installed in conformance with Contract Drawings and submittals.
- C. Verify that deck is structurally sound to support installers, materials and equipment without damaging or deforming work.
 - 1. Start of installation indicates installer accepts conditions of existing deck surfaces.

3.02 APPLICATION / INSTALLATION:

- A. Install specified insulation using approved mechanical fasteners in accordance with manufacturer's latest written instructions and as required by governing codes and Owner's insurance carrier.
- B. Install with end joints staggered to avoid having insulation joints coinciding with joints in deck. In multi-layer installations, stagger joints in top and bottom layers.

3.03 CLEANING / PROTECTION:

- A. Remove trash and construction debris from insulation surface prior to application of roofing membrane.
- B. Do not leave installed insulation exposed to weather. Cover and waterproof with completed roof system immediately after installation.
 - 1. Temporarily seal exposed insulation edges at the end of each day.
 - 2. Remove and replace installed insulation that has become wet or damaged with new insulation.

- C. Protect installed insulation and roof cover from traffic by use of protective covering materials during and after installation.

END OF SECTION

SECTION 07 25 00

WEATHER BARRIERS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 DESCRIPTION OF WORK:

- A. This Section includes the following:

1. Weather barrier membrane.
2. Seam Tape.
3. Flashing.
4. Fasteners.

- B. Related Sections:

1. Section 05 40 00 – Cold Formed Metal Framing.
2. Section 06 10 00 - Rough Carpentry.
3. Section 07 92 00 - Joint Sealants.
4. Section 13 34 19 – Metal Building Systems.

1.03 REFERENCES:

- A. ASTM International:

1. ASTM C920; Standard Specification for Elastomeric Joint Sealants.
2. ASTM C1193; Standard Guide for Use of Joint Sealants.
3. ASTM D882; Test Method for Tensile Properties of Thin Plastic Sheeting.
4. ASTM D1117; Standard Guide for Evaluating Non-Woven Fabrics.
5. ASTM E84; Test Method for Surface Burning Characteristics of Building Materials.
6. ASTM E96; Test Method for Water Vapor Transmission of Materials.
7. ASTM E1677; Specification for Air Retarder Material or System for Framed Building Walls.
8. ASTM E2178; Test Method for Air Permeance of Building Materials.

- B. AATCC - American Association of Textile Chemists and Colorists:

1. Test Method 127 Water Resistance: Hydrostatic Pressure Test.
- C. TAPPI:
1. Test Method T-410; Grams of Paper and Paperboard (Weight per Unit Area).
 2. Test Method T-460; Air Resistance (Gurley Hill Method).
- 1.04 SUBMITTALS:
- A. Refer to Section 01 3300 - Submittal Procedures.
- B. Product Data: Submit manufacturer current technical literature for each component.
- C. Samples: Weather Barrier Membrane, minimum 8-1/2 inches by 11 inches.
- D. Quality Assurance Submittals:
1. Design Data, Test Reports: Provide manufacturer test reports indicating product compliance with indicated requirements.
 2. Manufacturer Instructions: Provide manufacturer's written installation instructions.
- E. Closeout Submittals:
1. Refer to Section 01 7700 - Closeout Procedures.
 2. Weather Barrier Warranty: Manufacturer's executed warranty form with authorized signatures and endorsements indicating date of Substantial Completion.
- 1.05 QUALITY ASSURANCE:
- A. Qualifications:
1. Installer shall have experience with installation of weather barrier assemblies under similar conditions.
 2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.
 3. Source Limitations: Provide weather barrier and accessory materials produced by single manufacturer.
- B. Pre-installation Meeting:
1. Refer to Section 01 3100 - Project Management and Coordination.
 2. Hold a pre-installation conference, two weeks prior to start of weather barrier installation. Attendees shall include Contractor, Installer, Owner's Representative, and Weather Barrier Manufacturer's Designated Representative.
 3. Review all related project requirements and submittals, status of substrate work and preparation, areas of potential conflict and interface, availability of weather barrier assembly materials and components, installer's training requirements, equipment, facilities

and scaffolding, and coordinate methods, procedures and sequencing requirements for full and proper installation, integration and protection.

1.06 DELIVERY, STORAGE AND HANDLING:

- A. Refer to Section 01 6000 - Product Requirements.
- B. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store weather barrier materials as recommended by weather barrier manufacturer.

1.07 WARRANTY:

- A. Refer to Section 01 7836 - Warranties and Bonds.
- B. Special Warranty:
 - 1. Special weather-barrier manufacturer's warranty for weather barrier assembly for a period of ten (10) years from date of final weather barrier installation.
 - 2. Approval by weather barrier manufacturer for warranty is required prior to assembly installation.

PART 2 - PRODUCTS:

2.01 WEATHER BARRIER:

- A. A non-perforated, nonwoven, non-absorbing, breathable membrane that resists air flow, bulk water and wind driven rain and channels water and moisture to the outside of the building envelope. It has microscopic pores that allow moisture vapor to escape from inside walls.
 - 1. Basis of Design: DuPont Tyvek Commercial Wrap.
 - 2. Products of manufacturers listed below meeting indicated standard and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to approval of product list and samples:
 - a. CertainTeed Corporation.
 - b. James Hardie.
 - c. Typar, Berry Global, Inc.
 - 3. Section 01 6000 - Product Requirements: Product Selection procedures: Substitutions: Permitted.
- B. Physical Properties:
 - 1. Spunbonded polyolefin membrane.
- C. Performance Characteristics:

1. Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178, Type I per ASTM E1677.
2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.
3. Water Penetration Resistance: Minimum 280 cm when tested in accordance with AATCC Test Method 127.
4. Basis Weight: Minimum 2.7 oz/yd², when tested in accordance with TAPPI Test Method T-410.
5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.
6. Tensile Strength: Minimum 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.
7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.
8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84. Flame Spread: 10, Smoke Developed: 10.

2.02 ACCESSORIES:

- A. Seam Tape: As recommended by the weather barrier manufacturer.
- B. Fasteners:
 1. 1-5/8-inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer.
- C. Sealants:
 1. Refer to Section 07 9200 - Joint Sealants.
- D. Adhesives:
 1. Provide adhesive recommended by weather barrier manufacturer.
- E. Primers:
 1. Provide flashing manufacturer recommended primer to assist in adhesion between substrate and flashing.
- F. Flashing:
 1. Flexible membrane flashing materials for penetrations recommended by manufacturer.
 2. Straight flashing membrane materials for sealing penetrations recommended by manufacturer.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Verify substrate and surface conditions are in accordance with weather barrier manufacturer recommended tolerances prior to installation of weather barrier and accessories.

3.02 INSTALLATION - WEATHER BARRIER:

- A. Install weather barrier over exterior substrate in accordance with manufacturer recommendations.
- B. Overlap weather barrier:
 - 1. Seams: minimum 6 inches.
- C. Weather Barrier Attachment:
 - 1. Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommend fasteners, space 12-18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.

3.03 SEAMING:

- A. Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams.
- B. Seal any tears or cuts as recommended by weather barrier manufacturer.

3.04 PROTECTION:

- A. Protect installed weather barrier from damage.

END OF SECTION

SECTION SECTION 07 26 00

VAPOR BARRIERS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Section includes: Provide vapor barriers, moisture-retardant membranes and underlayments, including sealing joints and protrusions through membranes, with accessories as required for complete installation.
- B. Related Sections:
 - 1. Section 03 15 00 – Concrete Accessories.
 - 2. Section 03 30 00 – Cast-In-Place Concrete.
 - 3. Section 07 21 00 – Thermal Insulation.
 - 4. Section 07 92 00 – Joint Sealants.
 - 5. Division 21 – Fire Suppression.
 - 6. Division 22 – Plumbing
 - 7. Division 23 – Mechanical
 - 8. Division 26 – Electrical
 - 9. Division 27 - Communications
 - 10. Section 31 31 00 – Soil Treatment.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's literature for each type of membrane.
- B. Samples: Submit samples of each type of membrane.
- C. Quality Assurance/Control Submittals: Submit either test reports or manufacturer's certificates indicating materials comply with specified requirements.

PART 2 - PRODUCTS:

2.01 MANUFACTURER:

- A. Basis of Design: Stego Industries, LLC; 1-877-464-7834.
 - B. Products of manufacturers listed below meeting indicated standard and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to approval of product list and samples:
 - 1. W.R. Meadows, Inc.
 - C. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Permitted.
- 2.02 MATERIALS:
- A. Vapor Retarders (Underslab): Stego Wrap Vapor Barrier, a 15-mil polyolefin manufactured from ISO certified virgin resins.
 - 1. Types: Premium.
 - 2. Reference Standard: ASTM E 1745-97 Class A (premium).
 - 3. Puncture Resistance: 2,500 grams (premium), ASTM D 1709.
 - 4. Water Vapor Permeance: Less than .01 perms (premium), ASTM F-1249/ASTM E-96.
 - B. Curing Membranes: For use under all concrete slabs on grade not specifically indicated to be underlain with vapor barrier.
 - 1. Six (6) mil polyethylene sheeting.
- 2.03 ACCESSORIES:
- A. Provide products recommended by membrane manufacturer for complete installation.
 - B. Adhesives: Types as recommended by membrane manufacturer for specific materials and application indicated.
 - C. Joint Sealers: Pressure sensitive tape or mastic as recommended by membrane manufacturer for specific material and application indicated.
 - D. Sealant: Polyurethane, one-component balanced modulus, moisture curing, non-sag elastomeric sealant.
 - 1. Reference Standards: AAMA 808.3-92 (Exterior Perimeter Sealing Compound); ASTM C-920 Type S, Grade NS, Class 25.
 - E. Penetration Seal: Pre-sized, multi-purpose penetration seal manufactured from puncture resistant polyolefin membrane.

PART 3 - EXECUTION:

3.01 PREPARATION:

- A. Ensure items which pass through membrane are properly and rigidly installed, substrate is free of projections and irregularities which may be detrimental to proper installation of membrane.
- 3.02 INSTALLATION:
- A. Apply membrane in accordance with manufacturer's recommendations, laid smooth without folds or bunches of materials.
 - 1. Seam Overlap: As recommended by membrane manufacturer for specific membrane material and application indicated.
 - 2. Sealing: Seal edges and items projecting through vapor retarders and vapor barriers.
 - B. Inspect and repair membrane prior to application of finish material over membrane; tape tears, perforations and similar damage.

END OF SECTION

SECTION 07 41 13
METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Factory-formed metal roofing or soffits, including flashing and accessories.

1. Metal roofing includes: Tite-Loc Plus.

B. Related Sections: Sections related to this section include:

1. Section 05 3100 - Steel Decking.
2. Section 06 1000 - Rough Carpentry
3. Section 07 2200 - Roof and Deck Insulation.
4. Section 07 3010 - Roofing Underlayment.
5. Section 07 6200 - Sheet Metal Flashing & Trim
6. Section 07 9200 - Joint Sealants.
7. Division 22 - Plumbing.
8. Division 23 - Mechanical.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM E283/1680 - Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
3. ASTM E331/1646 - Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
4. ASTM 1592-95 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

B. Underwriters Laboratories (UL Classified Tests):

1. UL 580 - Test for Wind-Uplift Resistance of Roof Assemblies
2. UL 2218 - Impact Resistance Test

C. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. SMACNA Architectural Sheet Metal Manual

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide sheet metal roofing that has been manufactured, fabricated and installed to withstand structural and thermal movement, wind loading and weather exposure to maintain manufacturer's performance criteria without defects, damage, failure of infiltration of water.
 1. Wind-Uplift: Roof panel assembly shall comply with UL Classification 580 for UL Classified 90 rated assemblies
 2. Static Air Infiltration: Completed roof system shall have a maximum of .06 cfm/sf with 6.24 kPa air pressure differential as per ASTM E283/1680.
 3. Water Infiltration: No evidence of water penetration at an inward static air pressure differential of not less than 6.24 psf (43 kPa) and not more than 12.0 psf (83 kPa) as per ASTM E331/1646.

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
 1. Product Data: Submit product data, including manufacturer's SPEC-DATA product sheet, for specified products.
- B. Shop Drawings:
 1. Submit complete shop drawings and erection details, approved by the metal roofing manufacturer, to the architect for review. Do not proceed with manufacturer of roofing materials prior to review of shop drawings and field verification of all dimensions. Do not use drawings prepared by the architect for shop or erection drawings.
 2. Shop drawings show roof plans, elevations, methods of erection, and flashing details.
- C. Performance Tests:
 1. Submit certified test results by a recognized testing laboratory in accordance with specified test methods for each panel system.
- D. Samples: Submit verification samples for finishes, colors and textures.
- E. Quality Assurance Submittals: Submit the following:
 1. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements.
 2. Manufacturer's Instructions: Manufacturer's installation instructions.
- F. Closeout Submittals: Submit the following:
 1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals, Maintenance Data and Operation Data

Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

2. Project Warranty: Warranty documents specified herein.

G. Manufactures warranty: Submit, for owner's acceptance, manufactures standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not limited of, other rights the owner may have under the contract documents.

1. Warranty Period: Twenty (20) years commencing on Date of Substantial Completion.

2. Record Documents: Project record documents for installed materials in accordance with Division 1 Closeout Submittals, Project Record Documents Section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing work of this section who has specialized in the installation of work similar to that required for this project.

1. Certificate: Submit certificate indicating qualifications.

B. Sheet Metal Industry Standard: Comply with Sheet Metal and Air Conditioning Contractors National Association(SMACNA) Architectural Sheet Metal Manual.

C. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, Manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Section 01 3100 Project Management and Coordination, Project Meetings Section.

1.06 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1 Product Requirements Sections.

1. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Identify fabricated components with UL 90 Classified label where appropriate.

C. Storage and Protection: Store materials protected from exposure to harmful conditions. Store material in dry, above ground location.

1. Stack prefinished material to prevent twisting, bending, abrasion, scratching and denting. Elevate one end of each skid to allow for moisture to run off.

2. Prevent contact with material that may cause corrosion, discoloration or staining.

3. Do not expose to direct sunlight or extreme heat trim material with factory applied strippable film.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

1.08 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not a limitation of, other rights Owner may have under the Contract Documents.
 - 1. Warranty Period: Twenty (20) years commencing on Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SHEET METAL ROOFING

- A. Acceptable Manufacturer: Petersen Aluminum Corporation
 - 1. Contact: Dave Landis; 102 Northpoint Parkway; Acworth, GA 30102; Telephone (800) 272-4482, (404) 797-2143; dlandis@petersenmail.com.
 - 2. Section 01 6000 - Product Requirements: Product selection procedures: Substitutions: Permitted.
- B. PAC-CLAD Tite-Loc Plus Panel panels and trim:
 - 1. Seam Height: 2" (50.2 mm) minimum seam height.
 - 2. Material: .040-inch gauge (.10 mm) alloy 3105-H14 Aluminum.
 - 3. Panel Dimension: 18in (457 mm) o.c.
 - 4. Texture: Striations
 - 5. Rating: UL Classified 90 rated (wind uplift) panel assembly.
 - 6. Flashing and Trim: .040-inch gauge (.10 mm) Aluminum.
 - 7. Fasteners: TITE-LOC PLUS galvanized steel, non-penetrating high-performance clips for roofing application and UL Classified 90 rated (wind uplift) assemblies and standard clips for mansard and fascia applications.
 - 8. Sealant Bead: Factory applied sealant bead.
- C. Panel Finish:
 - 1. Panel Topside: PAC-CLAD finish color selected from Petersen Aluminum Corp. standard cool and metallic colors.
 - 2. Panel Underside: Polyester washcoat with dry film thickness of 0.3 mils.

- D. PAC-CLAD Flashing and Trim: Manufacturer's standard flashing and trim profiles, factory formed, gauge as recommended by manufacturer, color and finish to match metal roofing panels.

2.02 RELATED MATERIALS

- A. General: Coordinate use of related materials:
 - 1. Roof deck sheathing: Refer to Section 07 2200.
 - 2. Underlayment: Ice & water shield: Refer to Section 07 3010
 - 3. Sealants: Elastomeric joint sealants. Refer to Section 07 9200.

2.03 FABRICATION

- A. General:
 - 1. Continuous Length: Fabricate panels 55' (16.2 m) and less in one continuous length.
 - 2. Trim and Flashings: Fabricate trim and flashings from same material as roof system material.
 - 3. Portable Roll Former: Panels fabricated by portable roll former shall not be approved.

2.04 FINISHES

- A. PAC-CLAD Factory Applied Finish:
 - 1. Topside: Full-strength fluoropolymer (70% Kynar 500) system of 1.0 mil (.025 mm) total dry film thickness.
 - 2. Underside: Wash coat of 0.3 - 0.4 mil dry film thickness.
 - 3. Texture: Smooth texture, dull matte specular gloss 25 - 35% at 60 degrees.
 - 4. Protective film: Strippable vinyl film applied during panel fabrication and finishing.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, recommendations and installations instructions for substrate verification, preparation requirements and installation.
 - 1. Strippable Film: Remove manufacturer's protective film, if any, from surfaces of roofing panels.

3.02 EXAMINATION

- A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for project installation in accordance with manufacturer's instructions.

3.03 PREPARATION

- A. Coordination: Coordinate metal roofing with other Work (drainage, flashing and trim, deck substrates, parapets, copings, walls) and other adjoining work to provide a non-corrosive and leak-proof installation.
- B. Dissimilar Metals: Prevent galvanic action of dissimilar metals.

3.04 INSTALLATION

- A. General: Install metal roofing panels to profiles, patterns and drainage indicated and required for leak-proof installation. Provide for structural and thermal movement at work. Seal joints for leak-proof installation.
 - 1. Seams: Provide uniform, neat seams.
 - 2. Fasteners: Conceal fasteners where possible in exposed work. Cover and seal fasteners and anchors for watertight and leak-proof installation.
 - 3. Sealant-Type Joints: Provide sealant-type joint where indicated. Form joints to conceal sealant. Comply with Division 7 Joint Sealants Section for Sealant installation.

3.05 FIELD QUALITY REQUIREMENTS

- A. Site Tests (Post Installation Testing): Owner reserves right to perform post installation testing of installed sheet metal roofing.
- B. Manufacturer's Field Services: Upon Owner's request, provide manufacturer's field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer's instructions

3.06 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance. Remove construction debris from project site and legally dispose of debris.

3.07 PROTECTION

- A. Protection: Protect installed product from damage during construction.

END OF SECTION

SECTION 07 46 00
FIBER CEMENT SIDING

PART 1 - GENERAL

1.01 SUMMARY:

A. Section Includes:

1. Fiber cement siding, panels, shingle, battens, trim, fascia, moulding and accessories.
2. Factory-finished fiber cement siding, panels, shingle, battens, trim, fascia, moulding and accessories.

B. Related Sections

1. Section 04 0523 - Masonry Accessories.
2. Section 05 4000 - Cold Formed Metal Framing.
3. Section 06 1000 - Rough Carpentry.
4. Section 07 2100 - Thermal Insulation.
5. Section 07 2500 - Weather Barrier.
6. Section 07 9200 - Joint Sealants.
7. Section 09 2216 - Non-Structural Metal Framing.
8. Section 09 9100 - Paint and Coatings.

1.02 REFERENCES

- A. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test, Tool and Tape.
- B. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01330.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.

3. Installation methods.

- C. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 4 by 6 inches (100 by 150 mm), representing actual product, color, and patterns.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.
- B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store siding on edge or lay flat on a smooth level surface. Protect edges and corners from chipping. Store sheets under cover and keep dry prior to installing.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

- A. Product Warranty: Limited product warranty against manufacturing defects.
 - 1. HardiPanel vertical siding for 50 years.
 - 2. HardieSoffit panels for 25 years.
 - 3. Artisan lap siding for 30 years.

4. HardieShingle siding for 30 years.
 5. HardieTrim boards for 10 years.
- B. Finish Warranty: Limited product warranty against manufacturing finish defects.
1. When used for its intended purpose, properly installed and maintained according to Hardie's published installation instructions, James Hardie's ColorPlus finish with ColorPlus Technology, for a period of 15 years from the date of purchase: will not peel; will not crack; and will not chip. Finish warranty includes the cost of labor and material.
- C. Workmanship Warranty: Application limited warranty for 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: James Hardie Building Products, Inc., which is located at: 26300 La Alameda Suite 400 ; Mission Viejo, CA 92691; Toll Free Tel: 866-274-3464; Tel: 949-367-4980; Email: [request info \(info@jameshardie.com\)](mailto:request_info@jameshardie.com); Web: <http://www.jameshardiecommercial.com>.
- B. Section 01 60 00-Product Requirements: Product selection procedures: Substitutions: Permitted.

2.02 SIDING

- A. Code Compliance Requirement for Materials:
1. National Evaluation Report No. NER 405 (BOCA, ICBO, SBCCI, IBC, IRC).
 2. Non-asbestos fiber-cement siding where required to be non-combustible shall be tested in accordance with ASTM E136.
- B. Board and Batten: Hardie Panel Vertical siding with battens siding as manufactured by James Hardie Building Products, Inc.
1. Sizes and shapes as indicated on drawings.
- C. Shingle Siding: HardieShingle siding as manufactured by James Hardie Building Products, Inc.
1. Type: Straight Edge siding panel 15.25 inches by 48 inches by ¼ inch thick.
 2. Exposure: 7 inches.
- D. Soffit Panels: HardieSoffit panels as manufactured by James Hardie Building Products, Inc.

1. Type: Non-Vented Smooth panel 1/4" thick by largest size necessary for conditions encountered.
- E. Trim: HardieTrim boards as manufactured by James Hardie Building Products, Inc.
 1. Type: 5/4 and 4/4 Trim boards in lengths and widths necessary for conditions encountered.
- 2.03 FASTENERS
 - A. Metal Framing: Manufacturer recommended self-drilling screws.
 - B. Wood Sheathing: Manufacturer recommended corrosion resistant nails or screws.
- 2.04 FINISHES
 - A. Factory Primer: Provide factory applied universal primer.
 - B. Primer: Factory primed by James Hardie.
 - C. Topcoat: Refer to Section 09 9100 and Exterior Finish Schedule.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If framing preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Minimum 20 gauge 3-5/8 inch (92 mm) C-Stud 16 inches maximum on center or 16 gauge 3-5/8 inches (92 mm) C-Stud 24 inches (610 mm) maximum on center metal framing complying with local building codes, including the use of water-resistive barriers and/or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.
 1. Install water-resistive barriers and claddings to dry surfaces.
 2. Repair any punctures or tears in the water-resistive barrier prior to the installation of the siding.
 3. Protect siding from other trades.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION - HARDIE PANEL SIDING

- A. Install materials in strict accordance with manufacturer's installation instructions.
- B. Block framing between studs where HardiePanel siding horizontal joints occur.
- C. Place fasteners no closer than 3/8 inch (9.5 mm) from panel edges and 2 inches (51 mm) from panel corners.
- D. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.
- E. Maintain clearance between siding and adjacent finished grade.
- F. Specific framing and fastener requirements refer to Tables 2 and 3 in National Evaluation Service Report No. NER-405.

3.04 INSTALLATION - HARDIE SHINGLE CLADDING

- A. Install materials in strict accordance with manufacturer's installation instructions.
- B. Substrate: Install a minimum 7/16 inch (11 mm) thick OSB wall sheathing or equivalent braced walls complying with applicable building codes.
- C. Starting: Install a minimum 1/4 inch (6 mm) thick lath starter strip at the bottom course of the wall.
- D. Maintain clearance between siding and adjacent finished grade.
- E. Apply starter course of 10 inches (254 mm) shingles or 9-1/2 inches (241 mm) lap siding overlapping the starter strip.
- F. Apply subsequent courses horizontally with a minimum 10 inch overlap at the top and a minimum 2 inch (51 mm) side lap. The bottom edge of the first two courses overlaps the starter strip.
- G. Fasten between 1/2 inch (13 mm) and 1 inch (25 mm) in from the side edge and between 8-1/2 inches (216 mm) and 9 inches (229 mm) up from the shingle bottom edge.
- H. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.
- I. Ensure vertical joints of overlapping shingle course do not align.
- J. Wind Resistance: Where a specified level of wind resistance is required, Hardie Shingle siding is installed to substrate and secured with a minimum two fasteners described in Table No. 6, 7 and 8 in National Evaluation Service Report No. NER-405.

3.05 INSTALLATION - HARDIE SOFFIT PANELS

- A. Install materials in strict accordance with manufacturer's installation instructions.

- B. Install soffits to metal stud framing members spaced a maximum of 24 inches on center. All edges must be supported by framing.
- C. Install water barriers and air barriers as required by local building codes.
- D. Ensure gutters have end caps. Maintain a minimum 1" gap between end caps and siding and trim. Install kickout flashing at roof-wall junctions.
- E. Position vent holes toward outside of eave for optimal air flow.
- F. Place fasteners no closer than 3/8 inch (9.5 mm) from panel edges and no closer than 1" away from corners when using soffit that is less than or equal to 12" wide.
- G. Install panels in moderate contact at ends, provide PVC or metal jointers, battens or leave appropriate gap and caulk.

3.06 INSTALLATION - HARDIE TRIM BOARDS

- A. Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.
- B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch (19 mm) or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.
- C. Place fasteners no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten maximum 16 inches (406 mm) on center.
- D. Maintain clearance between trim and adjacent finished grade.
- E. Trim inside corner with single board.
- F. Outside Corner Board: For 3/4 inch (19 mm) trim only. Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten HardieTrim board to HardieTrim board.
 - 1. Allow 1/8 inch gap between trim and siding.
 - 2. Seal gap with high quality, paint-able caulk.
 - 3. Shim frieze board as required to align with corner trim.
 - 4. Install HardieTrim fascia over structural subfascia.
 - 5. Overlay siding with HardieTrim moulding at windows, doors and inside corners.
 - 6. Fasten through overlapping boards. Do not nail between lap joints.
 - 7. Overlay siding with single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten HardieTrim boards to HardieTrim boards.

8. Shim frieze board as required to align with corner trim.
9. Install HardieTrim fascia over structural subfascia.

3.07 FINISHING

- A. Finish factory primed siding with a minimum of one coat of high quality 100 percent acrylic or latex or oil based exterior grade paint within 180 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

3.08 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING & TRIM

PART 1 - GENERAL:

1.01 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.

1.02 SUMMARY:

- A. Extent of each type of flashing and sheet metal work is indicated on drawings and by provisions of this section.
- B. Types of work specified in this section include the following:
 - 1. Metal counter flashing and base flashing.
 - 2. Metal wall flashings.
 - 3. Exposed metal trim.
 - 4. Miscellaneous sheet metal accessories.
- C. Related Sections:
 - 1. Section 03 3000 – Cast-In-Place Concrete.
 - 2. Section 04 0519 – Masonry Anchorage & Reinforcing.
 - 3. Section 04 0523 – Masonry Accessories.
 - 4. Section 04 2000 – Unit Masonry Assemblies.
 - 5. Section 04 7200 – Cast Stone Masonry.
 - 6. Section 06 1000 – Rough Carpentry.
 - 7. Section 07 1113 – Bituminous Dampproofing.
 - 8. Section 07 2100 – Thermal Insulation.
 - 9. Section 07 2419 – Exterior Insulation & Finish System with Moisture Drainage.
 - 10. Section 07 5423 – Thermoplastic Polyolefin Membrane Roofing.
 - 11. Section 07 7233 – Roof Hatches.
 - 12. Section 07 6500 – Flexible Flashing.
 - 13. Section 07 9200 – Joint Sealants.

- 14. Section 09 91 00 – Paints & Coatings.
- 15. Section 10 73 16 – Protective Covers.
- 16. Section 13 34 19 – Metal Building Systems.
- 17. Division 23 – Mechanical.

1.03 QUALITY ASSURANCE:

- A. Industry Standards: Provide products, which comply with applicable requirements of SMACNA (Architectural Sheet Metal Manual), except as otherwise indicated.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data, Flashing, Sheet Metal and Accessories: Submit manufacturer's technical product data, installation instructions and general recommendations for each specified sheet material and fabricated product.
- C. Samples of the following flashing, sheet metal and accessory items.
 - 1. 8" square samples of specified sheet materials to be exposed as finished surfaces.
 - 2. 12" long samples of factory-fabricated products exposed as finished work. Provide complete with specified factory finish.
- D. Shop Drawings: Submit shop drawings showing layout, profiles, methods of joining, and anchorage details including major counter-flashings, collector boxes and downspouts. Provide layouts at 1/4" scale and details at 3" scale.

1.05 PROJECT CONDITIONS:

- A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

1.06 WARRANTY:

- A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 10 years from date of Substantial Completion.

PART 2 - PRODUCTS:

2.01 SHEET METAL FLASHING AND TRIM MATERIALS:

- A. Sheet Aluminum: ASTM B 209, alloy 3003, temper H14, AA-C22A41 clear anodized finish; 0.0403" thick (18 gauge), except as otherwise indicated.

- B. Extruded Aluminum: Manufacturer's standard extrusions of sizes and profiles indicated, 60063-T52, AA-C22A41 clear anodized finish; 0.0808" minimum thickness (12 gauge) for primary legs of extrusions.
- C. Stainless Steel: Stainless steel sheet meeting the requirements of ASTM A167, Type 304 or 316, with No. 4 finish. Where stainless steel sheet gauge is not indicated, provide 26 gauge.

2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES:

- A. Fasteners: Same metal as flashing/sheet metal or other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
- B. Bituminous Coating: FS TT-C-494 or SSPC- Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.
- C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, non-drying, nonmigrating sealant.
- D. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with FS TT-S-00227, TT-S-00230, or TT-S-001543.
- E. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.
- F. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/ weather-resistant seaming and adhesive applications of flashing sheet.
- G. Polyethylene Underlayment: 6-mil carbonated polyethylene film; FS L-P-512.
- H. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, non-corrosive, size and gauge required for performance.
- I. Paper Slip Sheet: 5 lb. rosin-sized building paper.

2.03 FABRICATED UNITS:

- A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.
- B. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Form aluminum seams with epoxy seam sealer; rivet joints for additional strength where required.
- C.
- D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in work cannot be used or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).

- E. Sealant Joints: Where moveable, non-expansion type joints are indicated or required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.
- F. Separations: Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.
- G. Aluminum Extrusion Units: Fabricate extruded aluminum running units with formed or extruded aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.
- H. Shop Finish: Provide manufacturer's standard Kynar 500 shop finish on sheet metal (exposed units).
 - 1. Color shall be selected by the Architect from the manufacturer's full range of colors.

PART 3 - EXECUTION:

3.01 INSTALLATION REQUIREMENTS:

- A. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with SMACNA "Architectural Sheet Metal Manual". Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal 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 weatherproof.
- B. Underlayment: Where aluminum is to be installed directly on cementitious or wood substrates, install a slip-sheet of red rosin paper and a course of polyethylene underlayment.
- C. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.
- D. Install counterflashing in reglets, either by snap-in seal arrangement or by welding in place for anchorage and filling reglet with mastic or elastomeric sealant, as indicated and depending on degree of sealant exposure.
- E. Nail flanges of expansion joint units to curb nailers, at maximum spacing of 6" o.c. Fabricate seams at joints between units with minimum 3" overlap, to form a continuous waterproof system.
- F. General for Aluminum Fabrications: Comply with manufacturers written installation instructions and recommendations. Coordinate with installation of substrates to receive work of this section, with flashing, and wall construction; as required to ensure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor products included in this section securely to structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

3.02 CLEANING AND PROTECTION:

- A. Clean exposed metal surfaces, removing substances, which might cause corrosion of metal or deterioration of finishes.

- B. Protection: Installer shall advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration, other than natural weathering at time of Substantial Completion.

END OF SECTION

SECTION 07 65 00

FLEXIBLE FLASHING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. Deliver, store and handle materials to prevent inclusion of foreign materials or damage by water or physical damage in original packages until ready for use.
- B. Related Sections:
 - 1. Section 04 05 19 – Masonry Anchorage & Reinforcing.
 - 2. Section 04 05 23 – Masonry Accessories.
 - 3. Section 04 20 00 – Unit Masonry Assemblies.
 - 4. Section 04 72 00 – Cast Stone Masonry.
 - 5. Section 07 11 13 – Bituminous Dampproofing.
 - 6. Section 07 21 00 – Thermal Insulation.
 - 7. Section 07 62 00 – Sheet Metal Flashing and Trim.
 - 8. Section 07 92 00 – Joint Sealants.

1.03 SUBMITTALS:

- A. Samples: Submit one (1) sample of flashing material for approval of Architect.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable manufacturers:
 - 1. Wire Bond.
 - 2. York Manufacturing, Inc.
 - 3. Hohmann & Barnard, Inc.
- B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

- C. Flashing: A full, single sheet of 3 oz. CDA 110 Alloy Copper sheet with 060 temper conforming to ASTM B-370-98 bonded with a ductile asphalt per ASTM 449-89 Type II, Grade UC-20 in a quantity of not less than 1.4 oz./ft², between two layers of glass fabric weighing not less than 0.3 oz./ft²/layer with a minimum of 20 x 10 threads per inch.
- D. Adhesives: Asphaltic mastic as recommended by flashing manufacturer. Where anchors or other projections penetrate fabric, keep puncture to minimum size and butter with adhesive.

PART 3 - EXECUTION:

3.01 PREPARATION:

- A. All masonry surfaces receiving through-wall flashing shall be free from loose materials and reasonably smooth. There shall be no slopes that will form pockets or prevent free drainage of water to the exterior surfaces of the wall. All work shall be executed in conformance with the accepted trade practices.

3.02 INSTALLATION:

- A. Vertical Masonry Surfaces: Surfaces receiving through-wall flashing shall be sufficiently spotted with mastic to hold in place until the masonry is set. Secure in back wall mortar joint or to the metal studs as detailed.
- B. Foundation Sill Flashing: The flashing shall be hid in a slurry of fresh mortar and topped with a fresh full bed of mortar. The flashing shall be left flush with the exterior face of the masonry and be carried upward across the cavity a minimum of 6". Secure the flashing in the back wall mortar joint or to the metal studs. Where the sill and a column meet, the flashing shall be brought up the column a minimum of 10" and secured with mastic.
- C. Cavity Wall Flashing: Flashing shall be laid in a slurry of fresh mortar and topped with a fresh full slurry of mortar. Flashing shall be left flush with the exterior face of the masonry wall and carried through the wall, upward across the cavity a minimum of 6" and secured in the back wall mortar joint or to the metal studs.
- D. Head and Sill Flashing: The flashing shall start flush with the outside of the wall or lintel angle, then carried through or up the wall as indicated. Flashing shall extend 8" beyond each side of the opening and be turned up at the sides forming a pan. All corners shall be folded, not cut.
- E. Other Areas: All membrane flashing at other locations shall be installed in accordance with manufacturer's recommendations.
- F. Joining of Materials: Joints shall be made by lapping a minimum of 4" and coating the contacting surfaces with mastic.
- G. Weep Vents: All flashing installed through masonry shall be provided with proper drainage to outside. Weep vents shall be provided in the head joint, the first course immediately above the flashing. Weep vents shall be kept free of mortar droppings.
- H. Mortar Deflection: A mortar deflection device should be installed at all flashing locations to ensure proper weepage.

3.03 INSPECTION:

- A. In each area where membrane flashing has been installed, a minimum of three locations in the wall joint above the flashing shall be left clean of mortar for water to be forced into the opening to determine if flashing has been installed properly and weep holes provided in accordance with these specifications. All flashing that has been left exposed to the exterior should be trimmed flush with the exterior masonry at this time.

END OF SECTION

SECTION 07 72 33

DOUBLE DOME INDUSTRIAL ROOF HATCHES

PART 1 - GENERAL:

1.01 SUMMARY:

- A. Work Included: Provide factory-fabricated roof hatches for ladder access.

1.02 SUBMITTALS:

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Warranty: Submit executed copy of manufacturer's standard warranty.

1.03 QUALITY ASSURANCE:

- A. Manufacturer: A minimum of 5 years experience manufacturing similar products.
- B. Installer: A minimum of 2 years experience installing similar products.
- C. Manufacturer's Quality System: Registered to ISO 9001 Quality Standards including in-house engineering for product design activities.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-ventilated area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.05 WARRANTY:

- A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS:

2.01 MANUFACTURER:

- A. Basis-of-Design Manufacturer: Type D Roof Hatch by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: www.BILCO.com.
- B. ROOF HATCH:

- C. Furnish and install where indicated on plans metal roof hatch Type D, size width 48" clear x length 102" clear. Length denotes hinge side. The roof hatch shall be double leaf. The roof hatch shall be pre-assembled from the manufacturer.
- D. Performance characteristics:
1. Covers shall be reinforced to support a minimum live load of 40 psf (195kg/m²) with a maximum deflection of 1/150th of the span or 20 psf (97 kg/m²) wind uplift.
 2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
 3. Operation of the covers shall not be affected by temperature.
 4. Entire hatch shall be weather tight with fully welded corner joints on covers and curb.
- E. Covers: Shall be [select: 14 gauge (1.9 mm) galvanized steel or 11 gauge (2.3mm) aluminum] with a 3" (76mm) beaded flange with formed reinforcing members. Covers shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- F. Cover insulation: Shall be fiberglass of 1" (25mm) thickness, fully covered and protected by a metal liner [select: 22 gauge (.8mm) galvanized steel or 18 gauge (1mm) aluminum].
- G. Curb: Shall be 12" (305mm) in height and of [select: 14 gauge paint (1.9 mm) galvanized steel or 11 gauge (2.3mm) aluminum]. The curb shall be formed with a 3-1/2" (89mm) flange with 7/16" (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
- H. Curb insulation: Shall be rigid, high-density fiberboard of 1" (25mm) thickness on outside of curb.
- I. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe [for aluminum construction: welded to the curb assembly; for steel construction: through bolted to the curb assembly].
- J. Hardware
1. Heavy pintle hinges shall be provided
 2. Covers shall be equipped with an enclosed two point spring latch with interior and exterior turn handles
 3. Roof hatch shall be equipped with interior and exterior padlock hasps.
 4. The latch strike shall be a stamped component bolted to the curb assembly.
 5. Covers shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.

- 6. Hardware: All hardware shall be zinc plated and chromate sealed. [For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware].
- 7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
- K. Finishes: Factory finish shall be [select: alkyd based red oxide primed steel or mill finish aluminum].

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
 - 1. Test units for proper function and adjust until proper operation is achieved.
 - 2. Repair finishes damaged during installation.
 - 3. Restore finishes so no evidence remains of corrective work.

3.03 ADJUSTING AND CLEANING:

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

A. Section Includes:

1. Exterior silicone sealants.
2. Exterior and interior polyurethane traffic sealants.
3. Interior polyurethane sealants.
4. Interior latex sealants.
5. Interior silicone food contact sealants.
6. Interior sanitary silicone sealants.
7. Metal lap joint sealants.
8. Threshold and sheet metal bedding sealants.
9. Firestop systems.
10. Joint accessories.

B. Related Sections:

1. Division 3 – Concrete.
2. Division 4 – Masonry.
3. Division 5 – Metal Work.
4. Division 6 – Woods & Plastics.
5. Division 7 – Thermal & Moisture Protection.
6. Division 8 – Doors & Windows.
7. Division 9 – Finishes.
8. Division 10 – Specialties.

9. Division 12 – Furnishings.
10. Division 13 – Metal Building Systems.
11. Division 14 – Conveying Equipment.
12. Division 21 – Fire Suppression.
13. Division 22 - Plumbing
14. Division 23 – Mechanical.
15. Division 26 – Electrical.
16. Division 27 – Communications.
17. Division 28 – Electronic Safety and Security.
18. Division 31 – Earthwork.
19. Division 32 – Exterior Improvements.

1.03 REFERENCES:

A. ASTM International Inc.:

1. ASTM C 510 - Standard Test Method for Staining and Color Change of Single- or Multi-component Joint Sealants.
2. ASTM C 719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement (Hockman Cycle).
3. ASTM C 794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
4. ASTM C834 - Standard Specification for Latex Sealants.
5. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants.
6. ASTM C 1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
7. ASTM C 1193 - Standard Guide for Use of Joint Sealants.
8. ASTM C 1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
9. ASTM C 1311 - Standard Specification for Solvent Release Sealants.
10. ASTM D 2203 - Standard Test Method for Staining from Sealants.
11. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
12. ASTM E814 Test Method for Fire Tests of Through-Penetration Firestops.
13. ASTM E1966: Standard Test Methods for Fire Tests of Joints

B. Underwriters Laboratories, Inc. (UL):

1. UL 1479 Fire Tests of Through-Penetration Firestops.
2. UL 2079 Tests for Fire Resistance of Building Joint Systems.
3. UL Fire Resistance Directory:
 - a. Fills, Voids or Cavity Materials (XHHW).
 - b. Firestop Devices (XHJI).

1.04 SYSTEM DESCRIPTION:

- A. Performance Requirements: Provide firestop systems which have been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.05 SUBMITTALS:

A. Shop Drawings:

1. Submit details to show installation and interface between sealants and adjacent work.
2. Include UL Systems or other independent laboratory system classification number on shop drawings.

B. Product Data:

1. Materials list of items proposed to be provided under this Section;
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;

C. Samples:

1. Submit color charts for each sealant type for initial selection.
2. Submit standard cured color samples for each sealant type illustrating selected colors.

D. Manufacturer's Installation Instructions:

1. Submit manufacturer's published installation procedures.
2. Include instructions for completing sealant intersections when different materials are joined.

E. Manufacturer's Certificate:

1. Certify products are suitable for intended use and products meet or exceed specified requirements.
2. Certify applicator is approved by manufacturer.

F. Qualifications Data:

1. Submit applicator's qualifications, including reference projects of similar scope and complexity, with current phone numbers and contact names of architects and owners for verification.
- G. Manufacturer's Field Reports:
1. Indicate time present at project site.
 2. Include observations; indicate compliance with manufacturer's installation instructions, and supplemental instructions provided to installers.
- 1.06 CLOSEOUT SUBMITTALS:
- A. Operation and Maintenance Data:
1. Submit recommended inspection intervals.
 2. Submit instructions for repairing and replacing failed sealant joints.
- 1.07 QUALITY ASSURANCE:
- A. Perform work in accordance with the following:
1. Building Joints: ASTM C 1193.
- B. Single source responsibility for joint sealant and firestopping materials:
1. Obtain joint sealant and firestop materials from single manufacturer for each different product required.
 2. Manufacturer shall instruct applicator in procedures for each material.
- C. Regulatory Requirements:
1. Firestop System installation must meet requirements of ASTM E-814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of
 2. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
 3. For those firestop applications that exist for which no UL tested system is available through any manufacturer, a manufacturer's engineering judgment derived from similar independently tested system designs will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Manufacturer's engineer judgment drawings must follow requirements set forth by the International Firestop Council.
- 1.08 QUALIFICATIONS:
- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.
- B. Applicator Qualifications:

1. Company specializing in performing work of this section with minimum five years documented experience, minimum three successfully completed projects of similar scope and complexity, and approved by manufacturer.
2. Designate one individual as project foreman who shall be on site at all times during installation.

1.09 PRE-INSTALLATION MEETINGS:

- A. Convene meeting minimum two (2) weeks prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING:

- A. Accept materials on site in manufacturer's unopened original packaging. Inspect for damage.
- B. Store primers and sealants in cool dry location with ambient temperature range of 60 to 80 degrees F (15 to 27 degrees C).

1.11 ENVIRONMENTAL REQUIREMENTS:

- A. Do not install primers or sealants when atmospheric temperatures or joint surface temperatures are less than 40 degrees F (4 degrees C).

1.12 SCHEDULING:

- A. Schedule work so waterproofing, water repellents and preservative finishes are installed after sealants, unless sealant manufacturer approves otherwise in writing.
- B. Ensure sealants are cured before covering with other materials.

1.13 WARRANTY:

- A. Submit signed copies of the following warranties against adhesive and cohesive failure of sealant and against infiltration of water and air through sealed joint for period of 3 years from date of Substantial Completion.
 1. Manufacturer's standard warranty covering sealant materials.
 2. Manufacturer's standard warranty covering firestop materials.
 3. Applicator's standard warranty covering workmanship.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Tremco Sealant/Weatherproofing Division of RPM International, Inc.; (800) 852-8173.
- B. Section 01 6000 - Product Requirements: Product selection procedures: Substitutions: Permitted.

2.02 URETHANE SEALANTS:

- A. Single Component Urethane: ASTM C 920, Type S, Grade NS, Class 25, Uses T, NT, M, A, I Class II, O; single component, moisture curing, non-staining, non-bleeding, color as selected.

- 1. Vulkem 116.

2.03 SILICONE SEALANTS:

- A. Single Component Silicone: ASTM C920, Type S, Grade NS, Class 25; Uses NT, G, A and O: single component, neutral, non-staining, non-bleeding, color as selected.

- 1. Tremsil 200.

- B. Single Component Traffic Silicone: Low modulus, high performance, single component, gun grade sealant, color as selected.

- 1. Spectrem 800.

2.04 OTHER SEALANTS:

- A. Latex Sealant: ASTM C 834; single component, solvent curing, non-staining, non-bleeding, non-sagging; color as selected.

- 1. Tremflex 834.

- B. Butyl Sealant: ASTM C 1311, butyl or polyisobutylene, single component, nondrying, non-skinning, non-curing, color as selected..

- 1. Butyl Sealant.

2.05 FIRESTOP SYSTEMS:

- A. Firestopping Sealant: ASTM E 814, gun grade, neutral-cure silicone, color as selected.

- 1. TREMstop Fyre-Sil.

- 2. 3M Fire Barrier Sealant CP 25WB+.

- B. Product(s)/System(s) Testing: UL Fire Resistance Directory, Fill, Void or Cavity Materials (XHHW) and Firestop Devices (XHJI) for listed product(s)/system(s).

- C. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor and approved by the sealant manufacturer as compatible, subject to review by the Architect.

2.06 ACCESSORIES:

- A. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

- B. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

- C. Joint Backing: Round foam rod compatible with sealant; oversized 25 to 50 percent larger than joint width; recommended by sealant manufacturer to suit application

- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

- E. Masking tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Verify substrate surfaces and joint openings are ready to receive work.
 - 1. Verify joint surfaces are clean and dry.
 - 2. Ensure concrete surfaces are fully cured.
- B. Report unsatisfactory conditions in writing to the Architect;
- C. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION:

- A. Prepare joints in accordance with ASTM C 1193 and manufacturer's instructions.
- B. Clean joint surfaces to remove dirt, dust, oils, wax, paints, and other contamination capable of affecting primer and sealant bond.
 - 1. Clean concrete joint surfaces to remove curing agents and form release agents.
- C. Protect elements surrounding the Work of this section from damage or disfiguration. Apply masking tape to adjacent surfaces when required to prevent damage to finishes from sealant installation.
- D. Surface Preparation: Prepare surface to receive firestop system products in accordance with manufacturer's instructions for surface preparation.
 - 1. Verify that penetrations and joints are properly sized.
 - 2. Secure all pipes, conduit, cable and other items which penetrate firestop materials.
 - 3. Comply with manufacturer's instructions relative to temperature and humidity conditions, before, during and after installation of firestopping materials.

3.03 SEALANT INSTALLATION:

- A. Install primer and sealants in accordance with ASTM C 1193 and manufacturer's instructions.
- B. Install joint backing to maintain the following joint ratios:
 - 1. Joints up to 1/2 inch (13 mm) Wide: 1:1 width to depth ratio.
 - 2. Joints Greater than 1/2 inch (13 mm) Wide: 2:1 width to depth ratio; maximum 1/2 inch joint depth.
- C. Install bond breaker where joint backing is not used.
- D. Apply primer where required for sealant adhesion.

- E. Install sealants immediately after joint preparation.
 - F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
 - G. Joining Silicone and Polyurethane Sealants:
 - 1. Install polyurethane sealants first.
 - 2. Join silicone sealant to polyurethane in accordance with manufacturer's instructions.
 - H. Tool exposed joint surface concave.
 - I. Regulatory Requirements: Install firestop materials in accordance with published Through-Penetration Firestop Systems in UL's Fire Resistance Directory or the publication of another approved independent laboratory.
 - J. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping materials.
 - 1. Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.
 - 2. Seal all joints to ensure an air and water-resistant seal, capable to withstand compression and extension due to thermal, wind or seismic joint movement.
 - 3. Consult with mechanical engineer, project manager prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
- 3.04 MANUFACTURER'S FIELD SERVICES:
- A. Require sealant manufacturer to be present at project site to:
 - 1. Observe sealant mockup installation and to issue reports of observations.
 - 2. Conduct field pre-construction testing.
 - 3. Examine sealed penetration and joint areas to ensure proper installation before concealing or enclosing areas.
 - 4. Keep areas of work accessible until inspection by applicable code authorities.
 - 5. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- 3.05 IDENTIFICATION:
- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - 1. The words: "Warning: Through-Penetration Firestop System – Do Not Disturb".
 - 2. Contractor's name, address and phone number
 - 3. Designation of applicable testing and inspection agency

4. Date of installation
 5. Manufacturer's name for firestop materials
- 3.06 CLEANING:
- A. Remove masking tape.
 - B. Clean adjacent surfaces soiled by sealant installation.
- 3.07 PROTECTION:
- A. Protection: Protect installed product from damage during construction.
- 3.08 SCHEDULE – SEALANT JOINTS:
- A. Exterior Sealant Joint [Type A]:
 1. Applications:
 - a. Control and expansion joints in cast-in-place concrete.
 - b. Control and expansion joints in unit masonry.
 - c. Butt joints between metal panels.
 - d. Joints between different materials listed above.
 - e. Perimeter joints between materials listed above and frames of doors, windows, louvers and similar openings.
 - f. Control and expansion joints in soffits and overhead surfaces.
 - g. Other exterior joints in vertical surfaces and non-traffic horizontal surfaces for which no other sealant is specified.
 2. Single Component Urethane Sealants:
 - a. Vulkem 116.
 - B. Interior Sealant Joint [Type B]:
 1. Applications:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints on exposed interior surfaces of exterior openings.
 - c. Perimeter joints between interior wall surfaces and frames of interior doors, windows, louvers, elevator entrances and similar openings.
 - d. Other interior joints in vertical surfaces and non-traffic horizontal surfaces subject to movement for which no other sealant is specified.
 2. Other Sealants:

- a. Tremflex 834.
- C. Traffic Sealant Joint [Type C]:
 - 1. Applications:
 - a. Control, expansion and isolation joints in cast-in-place concrete.
 - b. Joints between architectural precast concrete paving units.
 - c. Tile control and expansion joints.
 - d. Joints between different materials listed above.
 - e. Other interior and exterior traffic bearing joints in horizontal and sloped traffic surfaces
 - 2. Single Component Silicone Sealants:
 - a. Spectrem 800.
- D. Interior Food Contact Sealant Joint [Type D]:
 - 1. Applications:
 - a. Joints in kitchen counter tops and work surfaces.
 - b. Joints between food service equipment and surrounding construction.
 - c. Other interior joints where incidental food contact may occur.
 - 2. Single Component Silicone Sealants:
 - a. Tremsil 200.
- E. Interior Sanitary Sealant Joint [Type E]:
 - 1. Applications:
 - a. Joints in toilet room and bathroom counter tops.
 - b. Joints between plumbing fixtures and adjacent materials.
 - c. Joints between locker room lockers and adjacent materials.
 - d. Joints between food service equipment and surrounding construction.
 - e. Other interior joints in wet areas where needed to limit mold and mildew growth.
 - 2. Single Component Silicone Sealants:
 - a. Tremsil 200.
- F. Concealed Metal Lap Sealant Joint [Type F]:
 - 1. Applications:

- a. Concealed lap and hook joints in sheet metal flashing and trim.
 - 2. Single Component Non-Curing Sealants:
 - a. Tremco Butyl Sealant.
- G. Concealed Bedding Sealant Joint [Type G]:
- 1. Applications:
 - a. Bedding joints under metal thresholds and saddles.
 - b. Bedding joints between sheet metal flashing and other materials.
 - 2. Single Component Non-Curing Sealants:
 - a. Tremco Butyl Sealant.
- H. Firestopping System [Type H]:
- 1. Applications:
 - a. Penetrations for passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies) and vertical service shaft walls and partitions.
 - b. Safing slots gaps between edge of floor slabs and walls.
 - c. Openings between structurally separate sections of walls and floors.
 - d. Gaps between tops of walls and ceiling or roof assemblies.
 - e. Expansion joints in fire-rated walls and floors.
 - f. Openings and penetrations in fire-rated partitions or walls containing fire doors.
 - g. Openings around structural members which penetrate fire-rated floors or walls.
 - 2. Silicone Firestop Sealant:
 - a. TREMstop Fyre-Sil.
 - b. 3M Fire Barrier Sealant CP 25WB+.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY:

A. Section Includes:

1. Pressed steel hollow metal doors and frames.
2. Fire-rated hollow metal doors and frames.
3. Hollow metal window-walls, glazed openings, and other hollow metal frames for glass.
4. Rough bucks, frame reinforcing, door reinforcing, door insulation, closer reinforcements, clip angles and anchorage.
5. Factory prime paint finish.
6. Grouting of hollow metal frames with masonry mortar where not covered under other Sections.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete.
2. Section 05-40 00 – Cold Formed Metal Framing.
3. Section 06 10 00 – Rough Carpentry.
4. Section 07 92 00 – Joint Sealants.
5. Section 08 14 16 – Flush Wood Doors.
6. Section 08 71 00 – Door Hardware.
7. Section 08 80 00 – Glazing.
8. Section 08 88 13 – Fire-Rated Glass.
9. Section 09 20 00 – Gypsum Board.
10. Section 09 22 16 – Non-Structural Metal Framing.
11. Section 09 91 00 – Paints and Coatings.

12. Division 26 – Electrical.
13. Division 28 – Electronic Safety and Security.

1.03 REFERENCES:

A. American National Standards Institute (ANSI):

1. ANSI/SDI-100-98: Recommended Specifications - Standard Steel Doors and Frames, Steel Door Institute, unless herein specified.
2. ANSI A115.1-.17: Specification for Door and Frame Preparation for Hardware.
3. ANSI A115.1G-1994: Installation Guide for Doors and Hardware.
4. ANSI A156.7: Standard Template Hinge Dimensions.
5. ANSI A250.8-1998/SDI 100: Recommended Specifications for Standard Steel Doors and Frames.

B. American Society for Testing and Materials (ASTM):

1. ASTM-A 366-95A: Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
2. ASTM-A 568-95: Specification for Steel, Sheet, Carbon, and High Strength, Low-Alloy, Hot-Rolled, and Cold-Rolled.
3. ASTM-A 569-91a: Specification for Steel, Carbon, (0.15 maximum percent), Hot-Rolled Sheet and Strip Commercial Quality.
4. ASTM-A 924-95: General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
5. ASTM-E2074-2001: Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.

C. Door and Hardware Institute (DHI):

1. Sequence and Format for the Hardware Schedule, January 1996 edition.
2. Hardware for Labeled Fire Doors, January 1996 edition.
3. Abbreviations and Symbols, September 1983 edition.

D. Factory Mutual (FM):

1. Factory Mutual: Fire Tests of Door Assemblies.

E. International Building Code (IBC)

F. National Fire Protection Association (NFPA):

1. NFPA-80-1999: Standard for Fire Doors and Windows.
2. NFPA-252: Fire Tests of Door Assemblies.

G. Steel Door Institute (SDI):

1. SDI-105-98: Recommended Erection Instructions for Steel Frames.
2. SDI-106-99: Standard Door Type Nomenclature.
3. SDI-108-99: Recommended Selection and Usage Guide for Standard Steel Doors and Frames.
4. SDI-109-99: Hardware for Standard Steel Doors and Frames.
5. SDI-111-D: Recommended Door, Frame and Hardware schedule for standard steel doors and frames.
6. SDI-117-93: Manufacturing Tolerances Standard Steel Doors and Frames.
7. SDI-118-88: Standard Fire Door Requirements.
8. SDI-122-99: Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
9. SDI-124-88: Maintenance of Standard Steel Doors and Frames.
10. SDI-125-92: High Frequency Preparations for Frames.
11. SDI-127A-99: End Closure Location.
12. SDI-127B-99: Door Edge Cutouts.
13. SDI-127C-99: Frame Cutout Limits.
14. SDI-127D-99: Electric Strikes in Stud Walls.
15. SDI-129: Hinge and Strike Spacing.

H. Underwriters Laboratories, Inc. (UL):

1. UL 10C-98: Fire Tests of Door Assemblies.
2. UL 1784-90: Air Leakage Tests of Door Assemblies.

I. Warnock Hersey Inschape, Inc. (WHI):

1. WHI: Fire Tests of Door Assemblies.

1.04 SUBMITTALS:

- A. Door schedule to be formatted per SDI 111-D.
- B. Shop Drawings: Submit in accordance with Section 01330. Indicate general construction, configurations, jointing methods, reinforcements, and location of hardware and cutouts for glass and louvers.

1.05 QUALITY ASSURANCE:

- A. Applicable Standards: Specifications and standards of SDI 100-98.

- B. Hollow metal doors and frames to be manufactured by the same manufacturer.
 - C. Inspect products for damage and errors prior to shipment. Repair or replace as necessary prior to shipment.
 - D. Supplier Qualification: Qualified direct distributor of products to be furnished. The distributor shall have in their regular employment an A.H.C./C.D.C. (Architectural Hardware Consultant/Certified Door Consultant) or person of equivalent experience who will be available at reasonable times to consult with the Architect, Contractor and/or Owner regarding any matters affecting the total door and frame openings.
 - E. Repair or replace damaged or defective products prior to shipment from factory.
 - F. Installer Qualification: Experience with installation of similar materials.
 - G. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with UL-10C and NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with UL, WHI or FM and acceptable to authorities having jurisdiction.
 - 1. Temperature Rise Rating: Comply with temperature rise requirements as apply with UL-10C. At vertical enclosures, provide doors that have Temperature Rise Rating of 450 degrees F maximum in 30 minutes of fire exposure.
- 1.06 PRODUCT HANDLING:
- A. Deliver hollow metal doors in manufacturer's protective covering. Handle hollow metal with care to prevent damage.
 - B. Door Storage: Store doors in upright position, under cover. Place doors on at least 4 inch (101.6) high wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters that create a humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove wrapping immediately. Provide ¼ inch space between doors to promote air circulation.
 - C. Frame Storage: Store frames under cover on 4-inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, 5 units maximum in stack. Provide 1/4-inch space between frames to promote air circulation.
 - D. Handle and store hollow metal per manufacturer's instructions.
- 1.07 SEQUENCING AND SCHEDULING:
- A. Deliver doors and frames to the jobsite in a timely manner so as not to delay progress of other trades.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturers:

1. Ceco.
2. Curries.
3. Mesker.
4. Steelcraft.

B. Section 01600-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 HOLLOW METAL:

- A. Cold Rolled Steel Sheets: Commercial quality, stretcher leveled flatness, cold-rolled steel, free from scale, pitting or other surface defects, complying with ASTM A366 and A568 general requirements.
- B. Galvannealed Steel Sheets: ASTM A924, A60 zinc coating. Use galvannealed steel sheets at wet areas and for exterior hollow metal doors, door frames and door louvers. Internal reinforcing may be manufactured of hot rolled pickled and oiled steel per ASTM-A569.
- C. Minimum gauges of hollow metal are specified below. Provide heavier gauge if required by details or specific condition. Entire frame and sidelight shall be of same gauge.
 1. 16 gauge (0.053"): Interior door frames and glazed opening frames.
 2. 16 gauge (0.053"): Labeled frames (or heavier if required by label).
 3. 18 gauge (0.042"): Interior doors (or heavier if required by label).
 4. 14 gauge (0.067"): Exterior door frames, window-wall and window frames, transom and sidelight frames.
 5. 16 gauge (0.053"): Exterior doors.
 6. 20 gauge (0.032"): Trim members.
- D. Coating Materials, primer: Use manufacturer's standard rust inhibiting primer conforming to ANSI-A224.1-1990.

2.03 RELATED MATERIALS:

- A. Steel Reinforcing: ASTM A36.
- B. Door Bumpers or Silencers: Per ANSI A156.16.

2.04 HOLLOW METAL FRAMES:

A. Drywall Frames:

Manufacturer	Unequal Rabbet Drywall Frames
Ceco	DU Series
Curries	C Series
Mesker	FDJ Series
Steelcraft	DW Series

- B. General: Form to profiles indicated. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods. Frames to meet UL-10C Category C requirements.
- C. Typical Reinforcing: Provide minimum hinge reinforcement of 7-gauge material and lock strike reinforcement of 14-gauge material. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 12 gauge, including channel reinforcement for door closers and closer arms, door holders and similar items. Provide reinforcement and clearances for concealed in-head door closers and for mortise locks.
- D. Base Anchors: Provide one each sill anchor per jamb.
1. Drywall Frames: Provide galvanized x 16ga x inside jamb width base anchors to be concealed and adjustable.
- E. Jamb Anchors: Provide anchors in quantities and locations per manufacturer's recommendations.
1. Drywall: Provide galvanized twist in multi-purpose anchors x 18ga x inside jamb depth.
- F. Special Reinforcing: Prepare exterior doors from occupied areas with high frequency hinge reinforcement at the top hinge of each hinge jamb. Where continuous hinges are used, provide continuous minimum 14-gauge hinge reinforcement in both door and frame. All special hinge reinforcements are to be welded in place conforming to both SDI & manufacturers requirements.
- G. Cover Plates: For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.
- H. Hardware: Mortise, reinforce, drill and tap for mortise hardware. Drilling and tapping for surface applied hardware shall be done in field.
- I. Special Anchorage: Provide standard and special anchorage items as required. Provide 12 gauge angle clips at bottom of frames with punched holes for securing frames to floor, except where frames are secured entirely by rough bucks. Provide formed steel channel spreader at bottom of frames, removable without damaging frame. At masonry, provide sufficient anchors approximately 24 inches on center.
- J. Silencers: Provide specified silencers, except where stop does not occur and at smoke gasketed openings, 3 per jamb at single door and 2 for each door at double doors. Frames that receive silencers are to be properly prepared (punched) for them. Frames that have perimeter seals are not to be prepared (punched) for silencers.

- K. Extensions: Reinforce transom bars or mullions as necessary to provide rigid installation. Where required (as at multiple openings) to stabilize large frames, provide frame or mullion extensions to anchor to structure above, proper size to fit within overhead construction. Provide angle clips to fasten to structure.
- L. Clearances: Provide and be responsible for proper clearances at metal frames, including for weatherstripping, sound stripping and smoke gasketing. Glass clearance shall be thickness of glass plus clearance each side (1/8 inch minimum exterior - 1/16 inch minimum interior), adjust for installation, glass thickness to allow for glazing and sealant. Where sealed double glazing is indicated, provide rebates minimum of 3/4 inch and provide 1/4 inch clearance at glass edges. Where units fit around concrete blocks (blocks built into frames) obtain actual dimensions of blocks being used to establish minimum clearances.
- M. Stops: Frame stops to be integral and 5/8" inches in height.
- N. Labeled Frames: Construct in accordance with requirements for labeled work. Attach or emboss proper U.L., Warnock Hersey or F.M. label. Label may be metal, mylar or embossed and shall conform to the labeling requirements of the labeling entity.
- O. Welding: Face weld frames. Fabricate so no grind marks, hollow or other out-of-plane areas are visible. At joints of intermediate members (such as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.
- P. Finish: Clean frames by degreasing process and apply thorough coating of baked-on primer, covering inside as well as outside surfaces. At galvanized frames, coat welds and other disrupted surface with zinc-rich paint containing not less than 90 percent zinc dust by weight.

2.05 HOLLOW METAL DOORS:

A. Hollow Metal Doors:

Manufacturer	Flush Doors	Steel Stiffened	Temperature Rise
Ceco	Imperial Series	Medallion Series	Medallion Series (450 Deg.) Fuego Series (250 Deg.)
Curries	707 Series	747 Series	727 Series
Manufacturer	Flush Doors	Steel Stiffened	Temperature Rise
Mesker	NP Series	ST Series	NF Series
Steelcraft	LW Series	BW Series	TW Series

1. Flush Doors shall be used for Interior doors unless modified below.
2. Steel Stiffened doors shall be used for Exterior and Interior Reinforced doors as indicated below.
3. Temperature Rise doors shall be used for Labeled doors as indicated below.

- B. Provide to design indicated including: Flush panel doors and flush panel with cut-out as indicated. Use galvanized steel at exterior doors.

- C. Flush Doors: Reinforce, stiffen and sound deaden. Provide cutouts for glass and louvers with stops as shown. Provide flush steel closure at top of exterior and interior doors and at bottom of exterior doors with drain holes in bottom closure. Provide seamless edge stiles. The following door construction types are acceptable. Body filler or stitch weld with body filler is not acceptable.
1. Exterior Doors (and Interior Reinforced Doors): 20 gauge steel stiffener reinforced vertically 6 inches o.c. full height of door, spot welded 5 inches o.c. to both face sheets. Stiffeners welded together top and bottom. Insulate with 2-1/2 lb density mineral wool insulation.
 2. Door Construction: Manufacturer's standard polystyrene, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
- D. Lites: Exposed fasteners to be on the secure side of opening. Provide A60 galvanized lites in wet areas and at all exteriors.
1. Lites: Provide lite kits of minimum 20-gauge cold-rolled steel. Coordinate with Section 08800 Glass & Glazing for proper lite kits. Furnish Anemostat Lo Pro metal vision frame with GT glazing tape on fire rated openings.
 2. Labeled Doors: Comply with UL-10C Positive Pressure requirements for fire and smoke doors. Insulate as required by Underwriters Laboratories. Doors at vertical enclosures shall have a maximum transmitted temperature end point not to exceed 450 degrees F above ambient at end of 30 minutes of fire exposure specified in U.B.C. Standard No. 43-2.
- E. Labeled Doors: Comply with UL10-C Positive Pressure requirements for fire and smoke doors. Insulate as required by Underwriters Laboratories. Doors at vertical enclosures shall have a maximum transmitted temperature end point not to exceed 450 degrees F above ambient at end of 30 minutes of fire exposure specified in U.B.C. Standard No. 43-2.
- F. Typical Reinforcement: Mortise, reinforce, drill and tap for hardware furnished under Section 08711 – Finish Hardware. For lock reinforcement, provide manufacturer's standard reinforcement. Provide 12-gauge reinforcement for escutcheons or roses with centering clips to hold lock case in alignment. For door checks, provide 3/16-inch channel type reinforcements, 3-1/2 inch deep by 14 inches long, or as required. Hinge reinforcement minimum 7 gauge by 1-1/2 inch by 9-inch bar. Weld reinforcing to door. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface holders and door stops. Drilling and tapping installation of these surface items shall be done in field by hardware installer. Obtain all necessary templates from hardware supplier.
- G. Special Reinforcing: At exterior openings, reinforce door and frame with high frequency hinge preparation at top hinge of each door leaf.
- H. Top Caps: Provide manufacturer installed screw in steel top cap at all exterior out swing doors. Seal with UV resistant silicone sealant to be watertight. Coordinate with Section 07920 -Joint Sealants.
- I. Finish: Provide prime coat finish on doors. Thoroughly clean off rust, grease and other impurities. Grind welds smooth, no marks shall show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth.

- J. Lite Reinforcement: Provide minimum 20ga U channel welded to door faces around the inside perimeter of all lite cutouts.
- 2.06 FASTENINGS:
- A. Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide Jackson head screws, or flatter. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with #6 Jackson head self-tapping screws.
- 2.07 ASTRAGALS ON DOORS:
- A. Construction: Provide factory-installed formed astragals of no less than 16 gauge steel or flat astragals of no less than 14 gauge steel for double doors.
 - B. Hardware Preparation in Formed Astragals: Mortise, reinforce, drill and tap to receive mortise hardware in accordance with ANSI/SDI A250.6.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine supporting structure and conditions under which hollow metal is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Supplier to inspect jobsite to ensure an adequate dry and secure area is available to store the doors and frames prior to delivery.
- C. Storage area is to be free of trash and debris prior to delivery.

3.02 INSTALLATION:

- A. Install hollow metal in accordance with approved finish hardware schedule, shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship. Set hollow metal plumb, level, square to proper elevations, true to line and eye. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.
- B. Placing Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged. At in-place concrete or masonry construction, set frames and secure in place using countersunk bolts and expansion shields, with bolt heads neatly filled with metallic putty, ground smooth and primed.
- C. Place fire rated frames in accordance with NFPA-80 and manufacturers requirements.
- D. Apply continuous bead of caulk around the entire perimeter between the frame and wall at interior openings and use silicone sealant for exterior applications. Coordinate with Section 07920.
- E. Door Installation: Fit hollow metal doors accurately in their respective frames, within following clearances: Jambs and head 3/32 inch, meeting edges pair of doors 1/8 inch, sill where no threshold

or carpet 1/4 inch above finished floor, sill at threshold 3/4 inch maximum above finished floor, sill at carpet 1/4 inch above carpet. Tolerances shall also comply with SDI117 and manufacturers requirements.

- F. Coordinate installation of frames with Section 04 2000 Unit Masonry Assemblies.

3.03 ADJUSTING AND CLEANING:

- A. Prime Coat Touch-Up: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer. Coordinate with Section 09911. Only use materials that comply with hollow metal manufacturers requirements.
- B. Adjust doors and frames to comply with NFPA-80, NFPA-101 and manufacturers instructions and all applicable code requirements.
- C. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames. Protect doors and frames from damage by other trades and keep area around doors and frames free from trash and debris.
- D. Clean doors and frames per the manufacturers' instructions to be free from all drywall mud, grout, excess caulk, over spray and other foreign materials. Refer to Section 09911 Painting and Coatings so as not to damage finish paint and Section 08711 Finish Hardware so as not to damage finish on hardware. Do not allow acid or lacquer thinner to contact doors, frames or finish hardware.
- E. Repair damaged doors and frames per manufacturers instructions or replace to satisfaction of Architect.
- F. Replace defective doors and frames.

3.04 SCHEDULES:

- A. Submit, no more than three (3) weeks after installation is completed, three (3) copies of "AS BUILT" door and frame schedules and SDI 124 to the Architect.

END OF SECTION

SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 - GENERAL:

1.01 SUMMARY:

A. Section Includes:

1. Prefinished standard and fire-rated type wood doors with flush faces.
2. Prefit and premachine pre-finished wood doors.

B. Related Sections:

1. Section 06 10 00 - Rough Carpentry.
2. Section 08 11 13 - Hollow Metal Doors & Frames.
3. Section 08 71 00 - Door Hardware.
4. Section 08 80 00 - Glazing.
5. Division 26 – Electrical.

1.02 REFERENCES:

A. American National Standards Institute (ANSI):

1. A115-W – 1995, WOOD DOOR HARDWARE STANDARDS Hardware Preparations.
2. A117.1 – 1998, Accessible and Usable Buildings and Facilities.

B. American Society for Testing and Materials (ASTM):

1. ASTM E 119-00a, Standard Test Methods for Fire Tests of Building Construction and Materials.

C. Door and Hardware Institute (DHI):

1. Locations for architectural hardware for standard steel doors and frames, 1990.
2. Sequence and format for the hardware schedule, January 1996.
3. Hardware for Labeled Fire Doors, February 1993 edition.
4. Hardware for Health Care Facilities, June 1983.
5. Abbreviations and Symbols, September 1983.

D. HPVA – Hardwood and Plywood Veneer Association.

- E. International Building Code.
 - F. National Electrical Manufacturers Association (NEMA)
 - G. National Fire Protection Association (NFPA):
 - 1. NFPA-80 Standard for Fire Doors and Windows, 1999 edition.
 - 2. NFPA-80A Recommended Practice for Protection of Buildings from Exterior Fire Exposures, 2001 edition.
 - 3. NFPA-101 Life Safety Code, 2012 edition.
 - 4. NFPA-101B Code for Means of Egress for Buildings and Structures, 1999 edition.
 - 5. NFPA-105 Recommended Practice for the Installation of Smoke-Control Door Assemblies, 1999 edition.
 - 6. NFPA-252 Standard Methods of Fire Tests of Door Assemblies, 1999 edition.
 - H. Steel Door Institute (SDI):
 - 1. SDI-105-98 Recommended Erection Instructions for Steel Frames.
 - 2. SDI-117-93 Manufacturing Tolerances for Standard Steel Doors and Frames.
 - 3. SDI-122-99 Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 - 4. SDI-124-98 Maintenance of Standard Steel Doors and Frames.
 - I. Underwriters Laboratories (UL):
 - 1. UL 10C/UBC7-2-97 Fire Tests of Door Assemblies Positive Pressure
 - 2. UL 1784-90 Air Leakage Tests of Door Assemblies
 - 3. Door Assemblies Air Leakage Test (1784-90)
 - J. Uniform Building Code (UBC):
 - 1. UBC 7-2 1997, Fire Test of Door Assemblies.
 - K. Window and Door Manufacturers Association (WDMA):
 - 1. I.S.1-A-13 Industry Standard for Architectural Flush Wood Doors.
- 1.03 SUBMITTALS:
- A. General Requirements:
 - 1. Scope of work is to provide flush wood doors in compliance with the approved shop drawings, approved finish hardware schedule and approved door and frame schedule.
 - 2. Wood doors to meet positive pressure Category A requirements.
 - B. Shop Drawings and Product Data:

1. Submit in accordance with Section 01330.
2. Indicate general construction, jointing methods, hardware and louver locations, and locations of cutouts for glass. Indicate thickness of veneers.
3. Provide 6 copies of the approved door and frame schedule in the DHI horizontal format with shop drawings.

C. Schedules:

1. Provide door and frame schedule in the DHI horizontal format.
2. Door and frame schedule to be prepared by a CDC (Certified Door Consultant) or someone of comparable experience.

D. Product Data:

1. Provide catalog cuts of each item.

E. Samples:

1. Submit samples of wood veneer and factory finishing in accordance with WDMA Quality Standards I.S. 1-A 1997, sections G-18 and Guide Specifications 1.03 C.
2. Submit 12" x 12" corner sample of each different type of door, i.e. PC, SCL, FD1.

F. Wiring Diagrams:

1. Provide riser diagrams for electrified hardware and coordinate with electrical.
2. Show conduit in shop drawings and reference in door and frame schedule.

G. Operations and Maintenance Data: Provide the following as part of the closeout record document submittal in quantities required. Refer to Section 01 77 00.

1. As Built Door & Frame Schedule.
2. As Built Shop Drawings.
3. As Built Finish Hardware Schedule.
4. Wood Door Manufacturer's Installation Instructions.
5. Section 08 1113 Hollow Metal Doors and Frames.
6. Section 08 1416 Flush Wood Doors.
7. Section 08 7100 Door Hardware.
8. Each related specification Section.
9. Name, address and phone number of the wood door manufacturer.
10. Name, address and phone number of the local manufacturers representative.

11. Name, address and phone number of the material supplier and contact person.
12. Manufacturer's care and maintenance instructions.
13. Executed warranty (s).

H. Certification:

1. Submit certification that doors and frames comply with UBC 7-2 1997.

1.04 QUALITY ASSURANCE:

- A. Fire-Rated Wood Doors: Provide wood doors which are identical in materials and construction to units tested in door and frame assemblies in accordance NFPA 252 and which are labeled and listed for ratings indicated by ITS – Warnock Hersey, UL or other testing and inspection agency acceptable to authorities having jurisdiction.
 1. Doors: Comply with UBC 7-2 1997 where required.
 2. Provide intumescent requirements in compliance with UL-10C Category A.
- B. WDMA I.S. 1-A-13 Quality Standard: Window and Door Manufacturers Association Quality Standards for grade of door, core, construction, finish, and other requirements.
- C. Temperature Rise Rating: At stairwell enclosures, provide doors which have Temperature Rise Rating of 250 degrees F maximum in 30 minutes of fire exposure.
- D. Supplier Qualifications: Supplier to have a full time Certified Door Consultant (CDC) on staff or some of comparable experience. Supplier shall have warehousing and office facilities within 150 miles of project. Supplier to have been engaged in this type of business in jobsite area for 3 or more years.
- E. Certification of Label Construction:
 1. Warnock Hersey, Inc (WH)
 2. Underwriters Laboratories, Inc. (UL)
- F. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

1.05 DELIVERY STORAGE AND HANDLING:

- A. Site Conditions: Storage area for wood doors is to be in a dried, conditioned and secure area with controlled and stabilized humidity per manufacturer's recommendations.
- B. Marking and Packaging:
 1. Doors to be marked per the approved door and frame schedule.
 2. Doors to be individually bagged in minimum 1 mil. Opaque poly.
- C. Delivery: Coordinate delivery with Installer not less than 3 weeks prior to delivery.
- D. Storage:

1. Follow the Care and Installation guidelines as described in WDMA I.S. 1-A 13.
 2. Doors are to be stored flat and palletized with not more than 30 door leaves per pallet.
 3. Doors to be a minimum of 6" above floor while in storage.
- E. Handle doors with clean, white soft cotton gloves to prevent contamination by hand oils and dirt. Gloves are to be provided by whoever handles doors at any given time.
- F. Handle doors per manufacturer's recommendations.
- 1.06 GUARANTEE/WARRANTY:
- A. Guarantee: Provide manufacturer's guarantee for all wood doors. Guarantee period: Lifetime of original installation. Doors exhibiting defects in materials or workmanship including warp and delamination within guarantee period shall be replaced (including hanging and finishing) with new doors. These terms shall be part of the manufacturer's standard warranty.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturers:
1. Eggers Industries.
 2. Masonite Architectural.
 3. Oshkosh Door Company
- B. Section 01 60 00-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 MATERIALS:

- A. Door Construction:
1. General: Doors shall be 5-ply and comply with AWI / WDMA PC5 construction. Doors shall be manufactured by the hot-press method, bonding faces, crossbands and core together in a single operation with Type I glue. Doors manufactured by cold-pressing 2 or 3-ply pre-manufactured door skins to multiple cores in the same press will not be accepted.
 2. Non-Fire Rated Doors: Thickness: 1-3/4 inches, interior flush wood, bonded, solid core conforming to WDMA I.S. 1-A-13 and the following;
 - a. Core: bonded particle core (PC) or structural composite lumber (SCL) conforming to WDMA I.S. 1-A-13.
 - b. Door construction shall conform to WDMA I.S. 1-A-13 Premium Grade requirements.

- c. Stiles: Hardwood to match face veneer over structural composite lumber (SCL), glued to core. Minimum stile thickness of 1 3/8”.
- d. Rails: Mill option hardwood or SCL. Top and bottom: minimum of 1 1/8” inches.
- e. Facing: Wood veneer as specified.
- f. Acceptable manufacturers and products:

Manufacturer	PC Core	SCL Core
Eggers	Master Flush PC-5	Master Flush SCL-5
Masonite	Aspiro	Aspiro LSL
Oshkosh	GP5V	GT5V

3. Smoke-Control Doors: Thickness: 1-3/4 inches, interior flush wood, bonded, solid core conforming to WDMA I.S. 1-A-13 and the following;

- a. Core: bonded mineral core (FD) conforming to WDMA I.S. 1-A-13.
- b. Door construction shall conform to WDMA I.S. 1-A-13 Premium Grade requirements.
- c. Stiles: Hardwood to match face veneer over mineral composite, glued to core.
- d. Rails: Mineral composite as required by fire door authorities. Top and bottom: as required by manufacturer’s fire door authorities.
- e. Facing: Wood veneer as specified.
- f. Frame Applied Seals: Provide smoke seals by others as required to meet labeling requirements.
- g. Acceptable manufacturers and products:

Manufacturer	20 min. PC	20 min. SCL
Eggers	PC-5 Master Flush PP Cat. A	SCL-5 Master Flush PP Cat. A
Masonite	Aspiro Cat. A	Aspiro LSL Cat. A
Oshkosh	GP5V-20-PP-A	GT5V-20-PP-A

4. Fire Rated Doors: Thickness: 1-3/4 inches, interior flush wood, bonded, solid core conforming to WDMA I.S. 1-A-13 and the following;

- a. Core: Bonded mineral core (FD) conforming to WDMA I.S. 1-A 13.
- b. Door construction shall conform to WDMA I.S. 1-A-13 Premium Grade requirements.
- c. Stiles: Hardwood to match face veneer over mineral composite, glued to core.
- d. Rails: Mineral composite as required by fire door authorities. Top and bottom: as required by manufacturer’s fire door authorities.
- e. Facing: Wood veneer as specified.

f. Acceptable manufacturers and products:

Manufacturer	FD 3/4
Eggers	FireGuard Plus PP Cat. A
Masonite	Aspiro
Oshkosh	GFW545V-PP-A

B. Wood Veneer:

1. Door face veneers shall meet HPVA “A” grade quality standards conforming to WDMA I.S. 1-A for transparent or semi-transparent finish. Minimum face veneer thickness shall be 1/50” at 12% moisture content after finish sanding.
2. Species: Cherry.
3. Face Cut: Plain Sliced.
4. Face Assembly: Book Match.
5. Face Symmetry: Balanced Match.

C. Doors with Opaque Finish:

1. Doors shall have medium density overlay faces meeting Government standards PSI74. Overlay shall be readily sandable, weatherproof, and carry a Class “B” Fire Rating. Paint grade Birch or hardboard shall not be considered as meeting this specification.

D. Adhesives:

1. Adhesives: Face to core adhesives shall be Type I or Type II as appropriate for location in building. Adhesives must be classified Type I or Type II per WDMA TM-6 “Adhesive Bond Test Method.” Type I adhesives shall be used for doors in exterior applications, Type II adhesives may be used for doors in interior applications.

E. Core:

1. Non-rated and 20-minute doors: Solid particleboard 1-LD-2 or SCL.
2. Fire-rated doors: Non-combustible mineral core containing no asbestos.

2.03 FACTORY FINISHING:

A. Comply with referenced WDMA Section G-15, “Factory Finishing.”.

1. Pre-finish wood doors at factory.
2. Semi-transparent Finish: Submit manufacturer’s standard stain samples for selection.

2.04 ACCESSORIES:

A. Metal Vision Frames:

1. General: Provide minimum 20-gauge vision frames that protrude no more than 5/64" over face of door. At exterior and wet areas provide A60 or G60 vision frames.
2. Non-rated doors: Provide Anemostat Lo Pro metal vision frame.
3. Labeled Doors: Provide Anemostat Lo Pro metal vision frame with Anemostat GT Glazing Tape.
4. Fire-rated doors: ITS – Warnock Hersey or UL approved glazing system.
5. Glass: Refer to Section 08 8000 for glass types and thickness.
6. Fasteners: Provide manufacturers standard mechanical fasteners. Exposed fasteners to be on secure side of door.

2.05 FABRICATION:

- A. Fabricate wood doors in accordance with requirements of WDMA I.S. 1-A-13 Quality Standards.
- B. Fabricate fire rated doors in accordance with requirements of ITS – Warnock Hersey or Underwriters' Laboratories, with metal label on each door including UL-10C.
- C. Provide blocking for hardware per hardware manufacturers requirements for hardware to be installed without thru-bolts.
- D. Fabricate doors with WDMA Quality Standards hardware blocking options as follows:
 1. Provide HB-1 – head and HB-2 – sill rails and HB-4 – lock block on all doors.
 2. Provide HB-6 only when exit devices are specified for door.
 3. Provide HB-8 for pivots or when floor bolts are specified under Section 08711 – Door Hardware.
- E. Provide doors with minimum ¼ inch thick edge strips, of wood species to match face veneers except as required for fire rating.
- F. Make cut-outs and provide stops for glass and louvers. Install metal door louvers. Seal cut-outs prior to installation of moldings.
 1. For full light doors: Provide cut out from flush wood door, with vertical grain direction.
- G. Bevel lock and hinge edges of single acting doors 3 degrees or 1/8 inch in 2 inches. Radius strike edge of double acting swing doors as required by pivot hinge manufacturer.
- H. Prepare doors to receive hardware. Refer to Section 08 7100 - Hardware and NFPA 80 for hardware requirements including UL-10C.
 1. Prefit and bevel to net opening size less approximately 1/4 inch in width on single swing doors 3/16" inch in width for paired doors. Provide 1/4 inch clearance above finished floor, unless otherwise indicated on drawings. Provide 1/8 inch clearance at top of door.
 2. Slightly ease vertical edges.

- I. Fire Rated Pair of Doors; greater than 20-minute: Supply overlapping astragals or metal edge sets only as required by NFPA 80 1999 or by door manufacturer's fire door authorities. If an astragal is required, to comply with fire rated labeling requirements for pairs of fire rated doors, provide door manufacturer's standard tested astragal as required.
- 2.06 SOURCE QUALITY CONTROL:
- A. Inspect doors prior to shipment, any doors that are damaged, not machined properly or defective shall be repaired to manufacturer's quality standards for new doors or be replaced prior to shipment.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine installed door frames before hanging doors.
- B. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Inspect jobsite to ensure a dry and secure area that meets manufacturer's storage recommendations is available and ready to receive the doors prior to delivery of doors.

3.02 PREPARATION:

- A. Prior to delivery of wood doors, and while wood doors are being stored, the storage area shall:
 - 1. Be free of all trash and debris.
 - 2. Meet manufacturer's recommendations for storage of wood doors.
 - 3. Be conditioned and have stabilized humidity control.

3.03 INSTALLATION:

- A. Handle doors in accordance with recommendations of WDMA I.S. 1-A, "Care and Installation at Job Site."
- B. Condition doors to average temperature and humidity in area of installation for not less than 48 hours prior to installation. Store doors per recommendations of WDMA I.S. 1-A, "Care and Installation at Job Site."
- C. Install in neat and workmanlike manner, free from hammer or tool marks, open joints or slivers.
- D. Set plumb, level, square and true. Install doors after building humidity is at acceptable level.
- E. Remove and replace all warped, twisted, bowed, or otherwise damaged doors. Do not install doors that cannot be properly fitted to frames.

- F. Adjust prefinished doors and hardware and other moving or operating parts to function smoothly and correctly.
- G. If doors are to be field finished, the process must follow the WDMA I.S. 1-A, "Care and Handling at Job Site" instructions for field applied finishes.
- H. Ensure that smoke gaskets are in-place before prefinished door installation.
- I. Protect the work of other trades damage from the installation of doors and frames.
- J. Install doors in accordance with the following:
 - 1. Manufacturer's instructions, recommendations and tolerances.
 - 2. NFPA-80
 - 3. SDI-105
 - 4. Approved Finish Hardware Schedule
 - 5. Approved Door and Frame Schedule
 - 6. Approved Shop Drawings
 - 7. All applicable codes and requirements

3.04 FIELD QUALITY CONTROL:

- A. Test all openings with electrified hardware after installation to ensure proper operation.
- B. Manufacturer's representative is to inspect the jobsite upon substantial completion and provide a written report on any problems on the project. Provide 1 copy of this report to the material supplier, general contractor, architect, installer and the owner.
- C. All discrepancies listed in the report are to be corrected prior to final acceptance.

3.05 ADJUSTING AND CLEANING:

- A. Prior to final acceptance and at no additional cost to owner:
 - 1. Adjust doors to meet required tolerances.:
 - 2. General Contractor to clean doors per manufacturers instructions to be free from all foreign materials
 - 3. Repair damaged doors per manufacturer's instructions and guidelines.
 - 4. Replace damaged doors that cannot be repaired to the manufacturer's standards of quality.
 - 5. Replace defective doors.

3.06 DEMONSTRATION:

- A. Demonstrate and explain the operation of automatic doors to the building maintenance director and chief engineer prior to final acceptance.

3.07 PROTECTION:

- A. Keep poly bags on doors until date of acceptance.
- B. Protect doors from damage by other trades.
- C. Keep area around doors free from trash and debris.
- D. At clear finished doors, do not partially cover door surfaces with paper, cardboard, or any other opaque covering that will create uneven aging of wood veneer.
- E. Protect doors as directed under Section 01 7300.

END OF SECTION

SECTION 08 16 13
FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL:

1.01 SUMMARY

- A. Section includes requirements for fiberglass reinforced plastic (FRP) doors and frames.
- B. Glazing: Refer to Section 08 80 00

1.02 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:
 - 1. Section 04 20 00 – Unit Masonry Assemblies.
 - 2. Section 05 12 00 – Structural Steel Framing.
 - 3. Section 06 10 00 – Rough Carpentry.
 - 4. Section 07 92 00 – Joint Sealants.
 - 5. Section 08 71 00 – Door Hardware.
 - 6. Section 08 80 00 – Glazing.
 - 7. Section 09 22 16 – Non-Structural Metal Framing.

1.03 REFERENCES

- A. American Society for Testing and Materials
 - 1. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
 - 2. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics.
 - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including construction details, material descriptions, dimensions, and finishes for doors and frames.
- B. Shop Drawings: Submit detailed drawings showing door and frame profiles, dimensions, reinforcements, hardware preparations, and glazing/louver details.

- C. Samples: Provide samples of door and frame finishes, including gelcoat color and texture, for approval.
- D. Test Reports: Submit certified test reports for frame screw holding strength, including documented strength after third insert, as specified.
- E. Installation Instructions: Submit manufacturer's installation instructions for doors, frames, and hardware.
- F. Warranty: Submit manufacturer's standard warranty documentation

1.05 QUALITY ASSURANCE:

- A. Single Source Responsibility: Provide products by a single manufacturer capable of showing prior production of units similar to those required.
- B. Manufacturer's Qualifications: Minimum 5 years of experience producing fiberglass doors and frames of the type specified
- C. Installer's Qualifications: Minimum 5-years experience in the installation of systems similar to those required.

1.06 PROJECT CONDITIONS:

- A. Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames in protective packaging to prevent damage during transportation.
- B. Store products in a dry, well-ventilated area, protected from weather, moisture, and direct sunlight, in accordance with manufacturer's instructions

1.08 WARRANTY:

- A. Manufacturer's Warranty: Provide a written warranty covering defects in materials and workmanship for a minimum of 5 years from the date of substantial completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS

- A. Basis of Design: Fiberglass doors and frames shall be manufactured by Chem-Pruf Door Co., Ltd., or approved equal.

2.02 FIBERGLASS DOORS

- A. Products:

1. Doors shall be made of fiberglass reinforced plastic (FRP) using chemically proven resins resistant to contaminants typically found in the environment for which these specifications are written. Doors shall be 1-3/4 inches thick and of flush construction with no seams or cracks. All doors up to 4'-0" × 8'-0" shall have equal diagonal measurements with a maximum tolerance of +/- 1/32 inch.
2. Door Plates: Constructed as 1/8-inch-thick, molded in one continuous piece, starting with a 25-mil gelcoat of the color specified, integrally molded with at least two layers of 1.5 ounce per square foot fiberglass mat and one layer of 16 ounce per square yard unidirectional roving. This will yield a plate weight of 0.97 lbs. per square foot at a ratio of 30/70 glass to resin.
3. Stiles and Rails: Constructed starting from the outside toward the inside with a 25-mil gelcoat of the color specified, followed by a matrix of at least three layers of 1.5 ounce per square foot fiberglass mat. Stiles and rails shall be molded in one continuous piece to a U-shaped configuration to the exact dimensions of the door, with no miter joints or disparate materials.
4. Core Material: 2 psf expanded polyurethane foam, completely filling all voids between the door plates.
5. Internal Reinforcement: Firestop material in sufficient quantity to adequately support required hardware and its function.
6. Finish: Door finish shall be identical in color and texture to the frame. At time of manufacture, a 25-mil resin-rich gelcoat must be integrally molded into the door. Secondary painting to achieve color is not acceptable.

B. Window Openings

1. Window openings shall be provided at the time of manufacture and shall be completely sealed to prevent exposure of the door's interior to the environment.
2. Fiberglass retainers holding glazing shall be resin transfer molded with a profile that drains away from glazing and matches the color, texture, and finish of the door plates.
3. Glass shall be furnished and installed by the door and frame manufacturer

C. Louver Openings

1. Louver openings shall be sealed in the same manner as window openings.
2. Louvers shall be solid fiberglass inverted "V" vanes, matching the color, texture, and finish of the door plates

D. Transoms: Identical to doors in construction, material thickness, and reinforcement.

2.03 FIBERGLASS FRAMES

- A. Frames shall be fiberglass, manufactured using the resin transfer method in closed rigid molds to ensure uniformity in color and size. Frames shall begin with a minimum 25-mil gelcoat and a minimum of two layers of continuous strand fiberglass mat saturated with resin. Frames shall be of one-piece construction with molded stop.

B. Frame Profiles

1. Profiles up to 3/4 inch shall be solid fiberglass.
2. Profiles greater than 3/4 inch shall have a core material of 2 psf polyurethane foam.
3. Metal frames or pultruded fiberglass frames are not acceptable.

C. Finish:

1. Frame finish shall be identical in color and texture to the door.
2. A 25-mil resin-rich gelcoat shall be integrally molded into the frame at the time of manufacture. Secondary painting to achieve color is not acceptable.

D. Jamb/Header Connection: Copied by CNC for a tight fit

2.04 HARDWARE PREPARATION

A. Internal Reinforcement:

1. Continuous within the structure to allow for mounting of specified hardware.
2. Material shall be completely non-organic with a minimum hinge screw holding value of 656 lbs.
3. Frame screw holding value shall be a minimum of 1,000 lbs per screw. Submit documented strength of frame screw holding value after third insert.
4. Dissimilar materials, such as steel, are unacceptable for hardware attachment reinforcement

B. Mortises: Accurately machined by the manufacturer to hold dimensions to +/- 0.010 inch in all three axis.

C. Hinge Pockets: Accurately machined by the manufacturer to facilitate heavy-duty hinges at all hinge locations, using spacers when standard-weight hinges are used.

2.05 FABRICATION

- A. Fabricate doors and frames to comply with specified tolerances and performance requirements.
- B. Ensure all components are free of defects, including warpage, cracks, or surface imperfections.
- C. Coordinate hardware preparation with Section 08 71 00 - Door Hardware

2.06 RELATED MATERIALS:

- A. Glass: Refer to Division 8 Glass and Glazing Section for glass materials.
- B. Door Hardware: Refer to Division 8 – Door Hardware section, for finish hardware.

PART 3 - EXECUTION:

3.01 PREPARATION:

- A. Field Measurement: Wherever possible, take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work. However, proceed with fabrication and coordinate installation tolerances as necessary when field measurements might delay work.
- B. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.02 INSTALLATION:

- A. General: Install fiberglass doors and frames in accordance with manufacturer's instructions and approved shop drawings
- B. Frames
 - 1. Set frames plumb, square, and level, with secure anchorage to adjacent construction.
 - 2. Ensure jamb/header connections are tight and secure.
- C. Doors
 - 1. Hang doors to operate smoothly without binding or excessive clearance.
 - 2. Adjust door alignment to ensure equal diagonal measurements within specified tolerances.
- D. Hardware: Install hardware in accordance with Section 08 71 00 - Door Hardware, ensuring proper alignment and function
- E. Glazing and Louvers: Verify that glazing and louver installations are sealed and match the door's color, texture, and finish
- F.
- G. \Comply with manufacturer's instructions and recommendations for installation.
- H. Set units plumb, level and true to line without warp or rack of framing members, doors or panels. Provide proper support and anchor securely in place.
 - 1. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Comply with requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA-101-85.
- I. Set sill members and other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division-7 for sealants, fillers and gaskets.
- J. Refer to "Glazing" section of Division-8 for installation of glass and other panels indicated to be glazed into doors and framing, and not pre-glazed by manufacturer.

3.03 FIELD QUALITY CONTROL:

- A. Inspect installed doors and frames for compliance with specifications, including finish, alignment, and hardware operation.

- B. Manufacturer's Field Services: Upon request, provide manufacturer's field service consisting of site visit for inspection of product installation in accordance with manufacturer's instructions.

3.04 CLEANING AND PROTECTION

- A. Clean door and frame surfaces in accordance with manufacturer's instructions, removing dirt, debris, and smudges.
- B. Protect installed products from damage during remaining construction activities.

END OF SECTION

SECTION 08 33 23
OVERHEAD COILING DOORS

PART 1 - GENERAL:

1.01 SUMMARY:

- A. Section includes:
 - 1. Overhead coiling insulated doors.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 04 20 00 – Unit Masonry Assemblies.
 - 3. Section 05 50 00 – Metal Fabrications.
 - 4. Section 07 92 00 – Joint Sealants.
 - 5. Section 08 33 24 – Overhead Coiling Fire Doors.
 - 6. Section 08 71 00 - Door Hardware.
 - 7. Section 13 34 19 – Metal Building Systems.
 - 8. Division 26 – Electrical.
 - 9. Division 28 – Electronic Safety and Security.

1.03 REFERENCES:

- A. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A 924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA MG 1 - Motors and Generators.

- E. NFRC 102 - Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.
- 1.04 DESIGN / PERFORMANCE REQUIREMENTS:
- A. Overhead coiling insulated doors:
 - 1. Wind Loads: Design door assembly to withstand wind/suction load of 20 PSF without damage to door or assembly components in conformance with ASTM E 330.
 - 2. Operation: Design door assembly, including operator, to operate for not less than 100,000 cycles.
 - B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.
 - C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.
- 1.05 SUBMITTALS:
- A. Submit under provisions of Section 01 33 00.
 - B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Details of construction and fabrication.
 - 4. Installation methods.
 - C. Shop Drawings: Include detailed plans and elevations, details of framing members, anchoring methods, clearances, hardware, and accessories. Include relationship with adjacent construction.
 - D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
 - E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
 - F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
 - G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.

1.06 QUALITY ASSURANCE:

- A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years' experience in the fabrication and installation of security closures.
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum ten years and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
- C. Store materials in a dry, warm, ventilated weathertight location.

1.08 PROJECT CONDITIONS:

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 COORDINATION:

- A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.

1.10 WARRANTY:

- A. Warranty: Manufacturer's limited door and operators System warranty of all parts and components of the system except counterbalance spring and finish for 3 years or 100,000 cycles, whichever comes first.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturer:
 - 1. Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Web Site: www.overheaddoor.com. E-mail: sales@overheaddoor.com.
- B. Section 01 60 00 - Product Requirements: Product selection procedures: Substitutions: Permitted.

2.02 INSULATED OVERHEAD COILING SERVICE DOORS:

A. Overhead Coiling Stormtite Insulated Service Doors: Overhead Door Corporation Model 625.

1. Curtain: Interlocking roll-formed slats as specified following. Endlocks shall be attached to each end of alternate slats to prevent lateral movement.
 - a. Flat profile type F-265i for doors up to 40 feet (12.19 m) wide. Front slat fabricated of 24 gauge galvanized steel.
 - b. Back slat fabricated of 24 gauge galvanized steel.
 - c. Slat cavity filled with CFC-free foamed-in-place, polyurethane insulation, R-Value: 7.7, U-Value: 0.13, Sound Rating: STC-21.
2. Performance:
 - a. Through Curtain Sound Rating: Sound Rating: STC-28 (STC-30+ with HZ noise generator) as per ASTM E 90.
 - b. Installed System Sound Rating: STC-21 as per ASTM E 90.
 - c. U-factor: 0.91 NFRC test report, maximum U-factor of no higher than 1.00.
 - d. Air Infiltration: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft².
3. Finish:
 - a. Galvanized Steel: Slats and hood galvanized in accordance with ASTM A 653 and receive rust-inhibitive, roll coating process, including 0.2 mils thick baked-on prime paint, and 0.6 mils thick baked-on Powder top coat.
 - 1) Powder coat: PowderGuard Weathered Finish: Industrial textured powder coat provides a thicker, more scratch resistant coat. Applied to entire door system including slats, guides, bottom bar and head plate.
 - 2) Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
 - 3) Color selected by Architect from full range of standard colors.
4. Weatherseals:
 - a. Vinyl bottom seal, exterior guide and internal hood seals.
 - b. Interior guide weatherseal.
 - c. Lintel weatherseal.

- d. Air Infiltration Package, IECC 2012/2015 listed; product to meet C402.4.3 2012 Air leakage <1.00 cfm/ft².
 - 1) Air infiltration perimeter seal package includes: guide cover, guide cap, dual brush exterior guide seal, 4 inch finned lintel brush seal and vinyl bottom seal.
- 5. Bottom Bar:
 - a. Two prime painted steel angles minimum thickness 1/8 inch (3 mm) bolted back to back to reinforce curtain in the guides.
- 6. Guides: Three Structural steel angles
 - a. Finish: PowderGuard Weathered finish with iron/black powder.
- 7. Brackets:
 - a. Hot rolled prime painted steel to support counterbalance, curtain and hood.
- 8. Counterbalance: Helical torsion spring type housed in a steel tube or pipe barrel, supporting the curtain with deflection limited to 0.03 inch per foot of span. Counterbalance is adjustable by means of an adjusting tension wheel.
- 9. Hood: Provide with internal hood baffle weatherseal.
 - a. 24 gauge galvanized steel with intermediate supports as required.
- 10. Electric Motor Operation: Provide UL listed electric operator, size as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second.
 - a. Sensing Edge Protection: Electric sensing edge.
 - b. Operator Controls:
 - c. Key operation with open, close, and stop controls.
 - d. Controls for both interior and exterior location.
 - e. Controls surface mounted.
 - f. Motor Voltage: 115/230 single phase, 60 Hz.
- 11. Wind Load Design:
 - a. Standard wind load shall be 20 PSF.
- 12. Locking: None.

13. Wall Mounting Condition:
 - a. Face-of-wall mounting.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION:

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION:

- A. Install in accordance with manufacturer's instructions.
- B. Install rolling counter fire doors in compliance with requirements of NFPA 80. Test fire-release system and reset components after testing.
- C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- F. Coordinate installation of electrical service with Division 26. Complete wiring from disconnect to unit components.
- G. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 92 00.
- H. Install perimeter trim and closures.

3.04 ADJUSTING:

- A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
- B. Adjust hardware and operating assemblies for smooth and noiseless operation.

3.05 CLEANING:

- A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
- B. Remove labels and visible markings.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 PROTECTION:

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK:

- A. Extent of aluminum entrances and storefronts is indicated on drawings and schedules.
- B. Types of aluminum entrances and storefronts required for the project include the following:
 - 1. Exterior entrance doors.
- C. Glazing: Refer to “Glazing” Section of Division-8 for glazing requirements for aluminum entrances and storefronts, including doors specified to be factory-glazed.
- D. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 04 20 00 – Unit Masonry Assemblies.
 - 3. Section 04 72 00 – Cast Stone Masonry.
 - 4. Section 05 12 00 – Structural Steel Framing.
 - 5. Section 06 10 00 – Rough Carpentry.
 - 6. Section 07 62 00 – Sheet Metal Flashing & Trim.
 - 7. Section 07 81 00 – Applied Fireproofing.
 - 8. Section 07 92 00 – Joint Sealants.
 - 9. Section 08 44 13 – Glazed Aluminum Curtain Walls
 - 10. Section 08 71 00 – Door Hardware.
 - 11. Section 08 80 00 – Glazing.
 - 12. Section 09 20 00 – Gypsum Board.
 - 13. Section 09 22 16 – Non-Structural Metal Framing.
 - 14. Section 12 24 13 – Roller Window Shades.

1.03 SYSTEM DESCRIPTION:

- A. Performance Requirements: Provide aluminum entrance and storefront assemblies that comply with specified performance characteristics. Each system shall be tested by a recognized testing laboratory or agency in accordance with specified test methods. Provide certified test results.
- B. Thermal Movement: Provide systems capable of withstanding thermal movement resulting from ambient temperature range of 120°F that could cause a metal surface temperature range of 180°F within framing system.
- C. Wind Loading: Refer to the Structural drawings.

1.04 QUALITY ASSURANCE:

- A. Design Criteria: Drawings are based on one manufacturer's standard aluminum entrance and storefront system. Another manufacturer's system of a similar and equivalent nature will be acceptable when differences do not materially detract from design concept or intended performance as judged solely by Architect.
- B. Single Source Responsibility: Provide entrance and storefront produced by a single manufacturer capable of showing prior production of units similar to those required.
- C. Manufacturer's Qualifications: Provide entrances and storefront produced by a single manufacturer with not less than 5 years successful experience in the fabrication of assemblies of the type and quality required.
- D. Installer's Qualifications: Entrances and storefront shall be installed by a firm that has not less than 5-years successful experience in the installation of systems similar to those required.

1.05 SUBMITTALS:

- A. Product Data: Submit manufacturer's product specifications, technical product data, standard details and installation recommendations for components of aluminum entrances and storefronts required for project. Include the following information:
 - 1. Fabrication methods.
 - 2. Finishing.
 - 3. Hardware.
 - 4. Accessories.
- B. Shop Drawings: Submit shop drawings for fabrication and installation of entrances and storefronts, including elevations, detail sections of typical composite members, hardware mounting heights, anchorages and reinforcement, expansion provisions and glazing details.
- C. Samples: Submit pairs of samples of each type and color of aluminum finish, on 12" long sections of extrusions or formed shapes on 6" square sheets.
- D. Certification: Provide certified test results showing that entrance and storefront systems have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics.

1.06 PROJECT CONDITIONS:

- A. Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

1.07 WARRANTY:

- A. Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and Manufacturer, agreeing to repair or replace units (including re-glazing) which fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to structural failures including excessive deflection, excessive leakage or air infiltration faulty operation, and deterioration of metals, metal finishes and other materials beyond normal weathering. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
 - 1. Warranty period for aluminum entrances and storefront is 5 years after the date of Substantial Completion.

PART 2 - PRODUCTS:

A. ACCEPTABLE MANUFACTURERS:

- B. Manufacturer: Subject to compliance requirements, provide products of one of the following:

- 1. YKK Architectural Products.
- 2. Kawneer North America.
- 3. Tubelite Inc.

- C. Section 01 6000 – Product Requirements: Product Selection Procedures: Substitutions: Not Permitted.

2.02 MATERIALS AND ACCESSORIES:

- A. Aluminum Members: Alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish; ASTM B221 for extrusions, ASTM B209 for sheet or plate.
- B. Fasteners: Aluminum, non-magnetic stainless steel, or other materials warranted by manufacturer to be non-corrosive and compatible with aluminum components.
 - 1. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For the application of hardware, use fasteners that match the finish of member or hardware being fastened.
 - a. Provide Phillips flat-head machine screws for exposed fasteners.

2. Reinforcement: Where fasteners anchor into aluminum less than 0.125" thick provide non-corrosive press-in splined grommet nuts or other type reinforcement to receive fastener threads.
- C. Concealed Flashing: Dead-soft stainless steel, 26 gauge minimum, or extruded aluminum, 0.026" minimum, of an alloy and type selected by manufacturer for compatibility with other components.
- D. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible; otherwise, non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A386.
- E. Concrete/Masonry Inserts: Cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A386.
- F. Bituminous Coatings: Cold-applied asphalt mastic complying with SSPC-PS 12, compounded for 30-mil thickness per coat.
- G. Compression Weatherstripping: Manufacturer's standard replaceable stripping of either molded neoprene gaskets complying with ASTM D2000 or molded PVC gaskets complying with ASTM D2287.
- H. Sliding Weatherstripping: Manufacturer's replaceable stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.
- I. Glass and Glazing Materials: Provide glass and glazing materials which comply with requirements of "Glass and Glazing" section of these specifications.

2.03 COMPONENTS:

A. Exterior Aluminum Doors:

1. Basis of Design: YKK AP Series 35H Medium Stile Swing Doors.
2. Description: 3-1/2" (88.9 mm) Door Stile.
3. Corner Construction: Fabricate door corners joined by concealed reinforcement secured with screws and sigma deep penetration welding.
4. Glazing Stops: Manufacturer's standard snap-in glazing stops with EPDM glazing gaskets to prevent water infiltration.
5. Weather-stripping: Manufacturer's standard pile type in replaceable rabbets for stiles; manufacturer's standard EPDM bulb type in door frames.
6. Hardware: Manufacturer's standard as selected by Architect, unless indicated otherwise in Door Hardware section.

2.04 RELATED MATERIALS:

- A. Glass: Refer to Division 8 Glass and Glazing Section for glass materials.
- B. Door Hardware: Refer to Division 8 – Door Hardware section, for finish hardware.

2.05 FABRICATION:

- A. General: Sizes for door and frame units, and profile requirements are indicated on drawings. Any variable dimensions are indicated, together with maximum and minimum dimensions required to achieve design requirements and coordination with other work.
- B. Prefabrication: Before shipment to the project site, complete fabrication, assembly, finishing, hardware application and other work to greatest extent possible. Disassemble components only as necessary for shipment and installation.
 - 1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work in manner which prevents damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.
 - 2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
- C. Welding: Comply with AWS recommendations to avoid discoloration; grind exposed welds smooth and restore mechanical finish.
- D. Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.
- E. Dissimilar Metals: Separate dissimilar metals with zinc chromate primer, bituminous paint or other separator that will prevent corrosion.
- F. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting member.
 - 1. Uniformity of Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.
- G. Fasteners: Conceal fasteners wherever possible.
- H. Weatherstripping: For exterior and interior doors, provide compression weatherstripping against fixed stops; at other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.
 - 1. Provide EPDM or vinyl blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.
- I. At pairs of doors, both door leaves are active and will require closers and panic devices.

2.06 FINISHES:

- A. High Performance Organic Coating Finish:
 - 1. Type Factory applied two-coat 70% Kynar resin by Arkema or 70% Hylar resin by Solvay Solexis, fluoropolymer based coating system, Polyvinylidene Fluoride (PVF-2), applied in accordance with YKK AP procedures and meeting AAMA 2605 specifications.
 - 2. Colors: Classic Bronze; UC109850.
- B. Finishes Testing:
 - 1. Apply 0.5% solution NaOH, sodium hydroxide, to small area of finished sample area; leave in place for sixty minutes; lightly wipe off NaOH; Do not clean area further.

2. Submit samples with test area noted on each sample.

PART 3 - EXECUTION:

3.01 PREPARATION:

- A. Field Measurement: Wherever possible, take field measurements prior to preparation of shop drawings and fabrication, to ensure proper fitting of work. However, proceed with fabrication and coordinate installation tolerances as necessary when field measurements might delay work.
- B. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
 1. Aluminum Surface Protection: Protect aluminum surfaces from contact with lime, mortar, cement, acids, and other harmful contaminants.

3.02 INSTALLATION:

- A. Comply with manufacturer's instructions and recommendations for installation.
- B. Set units plumb, level and true to line without warp or rack of framing members, doors or panels. Provide proper support and anchor securely in place.
 1. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Comply with requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA-101-85.
- C. Set sill members and other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division-7 for sealants, fillers and gaskets.
- D. Refer to "Glazing" section of Division-8 for installation of glass and other panels indicated to be glazed into doors and framing, and not pre-glazed by manufacturer.

3.03 INSTALLATION:

- A. General: Install manufacturer's system in accordance with shop drawings, and within specified tolerances.
 1. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials using nylon pads or bituminous coating.
 2. Shim and brace aluminum system before anchoring to structure.
 3. Provide sill flashing at exterior storefront systems. Extend extruded flashing continuous with splice joints; set in continuous beads of sealant.
 4. Verify storefront system allows water entering system to be collected in gutters and wept to exterior.
 5. Verify metal joints are sealed in accordance with manufacturers installation instructions.

6. Locate expansion mullions where indicated on reviewed shop drawings.
7. Seal metal to metal storefront system joints using sealant recommended by system manufacturer.

3.04 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Services: Upon request, provide manufacturer's field service consisting of site visit for inspection of product installation in accordance with manufacturer's instructions.
- B. Field Test: Conduct field test to determine watertightness of storefront system. Conduct test in accordance with AAMA 501.2.

3.05 ADJUST AND CLEAN:

- A. Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.
- B. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.
- C. Clean glass surfaces after installation, complying with requirements contained in the "Glazing" section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

3.06 PROTECTION:

- A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

SECTION 08 41 23

FIRE RATED GLASS AND FRAMING SYSTEMS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

A. Section Includes:

1. Fire rated door and framing systems for installation as full vision fire-rated doors, sidelights, and transoms in interior openings.
2. Fire rated insulated glass units (IGU) installed as windows in fire rated frames.

B. Related Sections:

1. Section 06 10 00 – Rough Carpentry.
2. Section 07 92 00 – Joint Sealant.
3. Section 08 41 13 – Aluminum Storefront.
4. Section 08 71 00 – Door Hardware.
5. Section 08 80 00 – Glazing.
6. Section 09 20 00 – Gypsum Board.
7. Section 09 22 16 – Non-Structural Metal Framing.

1.03 REFERENCES:

A. American Architectural Manufacturers Association (AAMA):

1. AAMA 501.1-2005: Standard Test Method for Water Penetration of Windows, Curtain Walls, and Doors Using Dynamic Pressure.
2. AAMA 501.2-2003: Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
3. AAMA 501.5-2005: Test Method for Thermal Cycling of Exterior Walls.
4. AAMA 1503-1998: Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
5. AAMA 2603-2002 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

6. AAMA 2604-2005 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 7. AAMA 2605-2005 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- B. American Society for Testing and Materials (ASTM):
1. Material related:
 - a. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2007.
 - b. ASTM A 1011/A 1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2006b.
 2. Sound related:
 - a. ASTM E 90-04: Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - b. ASTM E 413-04: Standard Classification for Rating Sound Insulation.
- C. American Welding Society (AWS):
1. AWS D1.3 - Structural Welding Code - Sheet Steel; 2007.
- D. Builder's Hardware Manufacturers Association, Inc.:
1. BHMA, AL56-American National standards for Door Hardware; 2006 (ANSI/BHMA A156).
- E. National Fire Protection Association (NFPA):
1. NFPA 80: Standard for Fire Doors and Fire Windows.
 2. NFPA 251: Standard Methods of Tests of Fire Endurance of Building Construction and Materials.
 3. NFPA 252: Standard Methods of Fire Tests of Door Assemblies.
 4. NFPA 257: Standard on Fire Test for Window and Glass Block Assemblies.
- F. Underwriters Laboratories, Inc. (UL):
1. UL 9: Fire Tests of Window Assemblies.
 2. UL 10B: Fire Tests of Door Assemblies.
 3. UL 10C: Positive Pressure Fire Tests of Door Assemblies.
- G. American National Standards Institute (ANSI):

1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings.
- H. Consumer Product Safety Commission (CPSC):
 1. CPSC 16 CFR 1201 Categories I and II: Safety Standard for Architectural Glazing Materials.
- 1.04 DEFINITIONS:
 - A. Manufacturer: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.
- 1.05 SUBMITTALS:
 - A. Submit in accordance with Section 01 3300.
 - B. Product Data:
 1. Technical Information: Submit latest edition of manufacturer's product data providing product descriptions, technical data, Underwriters Laboratories, Inc. listings and installation instructions.
 - C. Shop Drawings:
 1. Include plans, elevations and details of product showing component dimensions; framed opening requirements, dimensions, tolerances, and attachment to structure.
 - D. Hardware Schedule: List of manufacturer supplied hardware and verification of cylinder size complying with Section 08 7100 – Door Hardware.
 - E. Samples: For following products:
 1. Glass sample as provided by manufacturer.
 2. Sample of frame.
 3. Verification of sample of selected finish.
 - F. Glazing Schedule: Use same designations indicated on drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
 - G. Warranties: Submit manufacturer's warranty.
 - H. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements.
 1. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.
- 1.06 QUALITY ASSURANCE:
 - A. Testing Agency Qualifications: Qualified according to

1. International Accreditation Service for a Type A Third-Party Inspection Body (Field Services ICC-ES Third-Party Inspections Standard Operating Procedures, 00-BL-S0400 and S0401)
2. International Accreditation Service for Testing Body-Building Materials and Systems
 - a. Fire Testing
 - 1) ASTM Standards E 119
 - 2) CPSC Standards 16 CFR 1201
 - 3) NFPA Standards 251, 252, 257
 - 4) UL Standards 9, 10B, 10C, 1784, UL Subject 63
 - 5) BS 476; Part 22: 1987
 - 6) EN 1634-1
- B. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
- C. Source Limitations for Glazing Accessories: Obtain framing system, glazing and glazing accessories from one source for each product and installation method indicated.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 252. Assemblies must be factory-welded or come complete with factory-installed mechanical joints and must not require job site fabrication.
- E. Listings and Labels - Fire Rated Assemblies: Under current follow-up service by Underwriters Laboratories® maintaining a current listing or certification. Label assemblies accordance with limits of manufacturer's listing.
- F. Regulatory Requirements: Comply with provisions of the following:
 1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG), as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Accessible doors no more than 5 lbf (22.2 N) push or pull force

- 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction
 2. Compliance with this standard requires auto openers to be added to the opening due to the weight of the doors. Coordinate the addition of auto-openers with the Division 8 section “Door Hardware” or other section containing these devices. Verify that the Authority Having Jurisdiction is using NFPA 101 and/or IBC and which edition dates of both as a requirement for the facility.
 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Door Closers: Not more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
- 1.07 DELIVERY, STORAGE AND HANDLING:
- A. Deliver, store and handle under provisions specified by manufacturer.
- 1.08 PROJECT CONDITIONS:
- A. Obtain field measurements prior to fabrication of frame units. If field measurements will not be available in a timely manner coordinate planned measurements with the work of other sections.
 1. Note whether field or planned dimensions were used in the creation of the shop drawings.
 - B. Coordinate the work of this section with others effected including but not limited to: other interior and/or exterior envelope components and door hardware beyond that provided by this section
- 1.09 WARRANTY:
- A. Provide the Fireframes® Designer Series standard five-year manufacturer warranty.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS - FIRE RATED DOOR ASSEMBLY:

- A. Glass Material: Pilkington Pyrostop® fire-rated glazing as fabricated and distributed by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065; phone (800-426-0279); e-mail tgp.sales@allegion.com , web site <http://www.fireglass.com>.
- B. Frame System: “Fireframes® Designer Series by TGP” fire-rated steel frame system as manufactured and supplied by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065 phone (800-426-0279); e-mail tgp.sales@allegion.com , web site <http://www.fireglass.com>.
- C. Section 01 6000 – product Requirements: Product Selection Procedures: Substitutions: Permitted.

2.02 PERFORMANCE REQUIREMENTS:

A. Fire Rating Requirements

1. Duration -- Doors: Capable of providing a fire rating for 60 minutes.
 - a. When glazed with Pilkington Pyrostop (60-90 minutes) glazing products, doors meet the maximum transmitted temperature rise of not more than 450 degrees Fahrenheit (250 degrees Celsius) at the end of 30 minutes of the standard fire test exposure.
2. Duration--Opening Applications in fire partitions or area separation walls and corridors where opening protection is specified: Capable of providing 60 minute rating.

B. Design Requirements:

1. Dimensions – Door and Framing:
 - a. Door framing face dimension: 1 15/16-inch
 - b. Depth of door framing: 1 15/16-inch.
 - c. Door style face dimension: 3 1/8-inch.
 - d. Door cross rail (if applicable) face: 3 9/16-inch.
 - e. Depth of stile, header, sill and cross rail: 1 15/16-inch.
2. Construction: Narrow-profile, roll-formed steel architectural grade specialty fire doors. Conventional break-shape type hollow metal steel fire-rated doors will not be considered an acceptable substitute for the Fireframes Designer Series doors specified in this section as they do not conform to the project design intent and/or aesthetic and quality standards.
 - a. Knock down frames are not permitted.

2.03 MATERIALS – GLASS:

- A. Fire Rated Glazing: ASTM C 1036 and ASTM C 1048; composed of laminated ceramic specially tempered glazing material.
- B. Thickness of Glazing Material: 3/4” to 1 9/16” Pilkington Pyrostop®.
- C. Approximate Visible Transmission: Varies with thickness (approximate range 88 percent).
- D. Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacturer, testing laboratory (UL® only), fire rating period, safety glazing standards, and date of manufacture.
- E. Performance: Glass must be rated to stop fire from either direction and must meet all testing requirements including the required hose-stream test (where fire-rating exceeds 20 minutes).

2.04 MATERIALS – STEEL FRAMES AND DOORS:

- A. Steel Framing System including 60-minute rated doors.
 1. Frame: Steel profiled formed tubing.

2. Fasteners: As recommended by manufacturer
3. Glazing Accessories: Calcium silicate setting blocks.
4. Glazing Compounds:
 - a. FireLite®, FireLite Plus®, FireLite® NT, FireLite® IGU, Fireglass®20, or Pilkington Pyrostop®: Approved closed cell PVC tape or pure silicone sealant.

2.05 FABRICATION:

- A. Furnish frame assemblies pre-welded.
 1. When necessary, splice frames too large for shop fabrication or shipping or to fit in available building openings.
 2. Fit with suitable fasteners.
 3. Knock-down frames are not permitted
- B. Field glaze frame assemblies.
- C. Factory prepare steel door assemblies and install all hardware.
- D. Fabrication Dimensions: Fabricate to fire-rated field dimensions.
- E. Obtain approved shop drawings prior to fabrication.

2.06 FINISHES, GENERAL:

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish frames after assembly.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

2.07 FACTORY FINISHES:

- A. Color-Coated Finish: Apply manufacturer's standard powder coating finish system complying with AAMA 2603 applied to factory-assembled frames before shipping, complying with manufacturer's written instructions for surface preparation including pretreatment, application, and minimum dry film thickness.
 1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.08 POWDERCOAT FINISHES:

- A. Finish after fabrication.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.
- C. Interior Steel Finishes

1. Powder-Coat Finish: Polyester Super Durable powder coating which meets AAMA 2604 for chalking and fading. Apply manufacturer's standard powder coating finish system applied to factory-assembled frames before shipping, complying with manufacturer's recommended instructions for surface preparation including pretreatment, application, and minimum dry film thickness.
2. Color and Gloss: As selected by Architect from manufacturer's full range.
3. Acceptable Manufacturers:
 - a. Tiger Drylac.
 - b. Additional manufacturers as approved by TGP.

2.09 DOOR HARDWARE:

- A. Furnish hardware with 60 minute fire door by the manufacturer.
- B. Select hardware from door manufacturer's standard recommended and approved hardware groups as specified in Division 8 Section – Door Hardware.
- C. Provide power assisted hardware for use at any door that cannot meet the opening force(s) required by code noted in Part I above.
 1. High energy, power-operated doors must meet the requirements of ANSI/BHMA A156.10 and power-assisted low energy doors must comply with ANSI/BHMA A156.19
- D. Operating hardware for Fireframes® Designer Series Active-Active Pair of Doors Outswing with Exit Device. Each pair to have the following:

Item	Description	Manufacturer	Finish*
6 Hanging Devices	Weld on Pivots	Technical Glass Products	PTM
2 Exit Device	3547A-F Concealed	Von Duprin	626
2 Lever Trim	360L	Von Duprin	626
1 Cylinder	ANSI Mortise Schlage C Keyway	Technical Glass Products	626
2 Closers	4040XP Surface Mounted	LCN	689
2 Auto door Bottoms	420APKL Smoke Seal	Pemko	MA
1 Auxiliary Fire Latch	Used with exit device with no bottom rod	Technical Glass Products	630
1 Weather Seal	Perimeter Gasket	Technical Glass Products	

Balance of hardware by others

* FINISH LEGEND:

PTM Painted to match frame

MA Mill Finish Aluminum

689 Aluminum Paint

630 Satin Stainless Steel

626 Satin Chrome Plated

2.10 ACCESSORY MATERIALS:

- A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine substrates and members to which the work of this section attaches or adjoins prior to frame installation.
- B. Provide openings plumb, square and within allowable tolerances.
- C. Provide 3/8 inch shim space at all walls
- D. Notify Architect of any conditions which jeopardize the integrity of the proposed fire wall / door system.
- E. Do not proceed until such conditions are corrected.

3.02 INSTALLATION:

- A. Follow manufacturer's written instructions and approved shop drawings.
- B. Install fully welded fire window in strict accordance with the approved shop drawings.
- C. Install fire safing / fire stopping at edges of system
- D. Install glazing in strict accordance with fire rated glazing material manufacturer's specifications.
 - 1. Field cutting or tampering is not permissible.
- E. Do not install damaged frames or chipped glazing units.
- F. Install plumb and true. Limit out of plumb or true to 1/8 inch in 10'-0" in any dimension.

3.03 REPAIR AND TOUCH UP:

- A. Limited to minor repair of small scratches. Use only manufacturer's recommended products.
 - 1. Such repairs shall match original finish for quality or material and view.

- B. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged.
- 3.04 PROTECTION AND CLEANING:
- A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
 - 1. Do not clean with astringent cleaners. Use a clean “grit free” cloth and a small amount of mild soap and water or mild detergent.
 - 2. Do not use any of the following:
 - a. Steam jets
 - b. Abrasives
 - c. Strong acidic or alkaline detergents, or surface-reactive agents
 - d. Detergents not recommended in writing by the manufacturer
 - e. Do not use any detergent above 77 degrees F
 - f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
 - g. Metal or hard parts of cleaning equipment must not touch the glass surface
 - B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
 - C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION

SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Section Includes: Aluminum Curtain Wall Systems:

- 1. YKK AP Series YHC 300 IG (Inside Glazed) Impact Resistant Aluminum Curtain Wall System.

- B. Related Sections:

- 1. Sealants: Dow Corning® 995 Structural Silicone Sealant.
 - 2. Glass and Glazing: Refer to Division 8 Glass and Glazing Section for glass and glazing requirements.
 - 3. Single Source Requirement: All products listed below shall be by the same manufacturer.
 - a. Section 08 4113 - Aluminum-Framed Entrances & Storefronts.

1.03 SYSTEM PERFORMANCE DESCRIPTION:

- A. All test unit sizes and configurations shall conform to the minimum sizes in accordance with; Florida High Velocity Hurricane Zone (HVHZ) Protocols, ASTM E 1886, ASTM E 1996, and meet all requirements of TAS 201, TAS 202, and TAS 203. They shall also comply with the following specific performance requirements indicated.

- 1. Air Infiltration: Completed curtain wall systems shall have 0.06 CFM/FT² (1.10 m³/h•m²) maximum allowable infiltration when tested in accordance with ASTM E 283 at differential static pressure of 6.24 PSF (299 Pa).
 - 2. Water Infiltration: No uncontrolled water, other than condensation, on indoor face of any component when tested in accordance with ASTM E 331 at test pressure differential of 20 PSF (958 Pa). Water test to be performed immediately after design pressure test.
 - 3. Wind Loads: Completed curtain wall system shall withstand wind pressure loads normal to wall plane indicated:
 - a. Structural Performance:
 - 1) Positive Pressure: Refer to structural drawings.
 - 2) Negative Pressure Refer to structural drawings.
 - b. Structural Safety Factor Performance:

- 1) Positive Pressure: Refer to structural drawings.
- 2) Negative Pressure: Refer to structural drawings.
4. Deflection: Maximum allowable deflection in any member when tested in accordance with ASTM E 330 with allowable stress in accordance with AA Specifications for Aluminum Structures:
 - a. Without Horizontals: $L/175$ or $3/4"$ (19.1mm) maximum.
 - b. With Horizontals: $L/175$ or $L/240 + 1/4"$ (6.4mm) for spans greater than 13'-6" (4.1m) but less than 40'-0" (12.2m).
5. Thermal Movement: Provide for thermal movement caused by 180 degrees F. (82.2 degrees C.) surface temperature, without causing buckling stresses on glass, joint seal failure, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or detrimental effects.
6. Thermal Performance: When tested in accordance with AAMA 1503 and NFRC 102:
 - a. Condensation Resistance Factor (CRF): A minimum of 63.
 - b. Thermal Transmittance U Value: 0.49 BTU/HR/FT²/°F or less.

1.04 SUBMITTALS:

- A. General: Prepare, review, approve, and submit specified submittals in accordance with "Conditions of the Contract" and Division 1 Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in "Conditions of the Contract."
- B. Product Data: Submit product data for each type curtain wall series specified.
- C. Substitutions: Whenever substitute products are to be considered, supporting technical data, samples and test reports must be submitted ten (10) working days prior to bid date in order to make a valid comparison.
- D. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, finish colors and textures.
- E. Samples: Submit verification samples for colors on actual aluminum substrates indicating full color range expected in installed system.
- F. Quality Assurance / Control Submittals:
 1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
 2. Installer Qualification Data: Submit installer qualification data.
- G. Closeout Submittals:
 1. Warranty: Submit warranty documents specified herein.

2. Project Record Documents: Submit project record documents for installed materials in accordance with Division 1 Closeout Procedures Section.

1.05 QUALITY ASSURANCE:

A. Qualifications:

1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project. If requested by Owner, submit reference list of completed projects.
2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction process.

B. Mock-Ups (Field Constructed): Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color and workmanship standard.

1. Mock-Up Size: 6' 0" high x 10' 0" wide.
2. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

C. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.06 PROJECT CONDITIONS / SITE CONDITIONS:

- ##### A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

1.07 WARRANTY:

- ##### A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.

- ##### B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by an authorized company official.

1. Warranty Period: Manufacturer's five (5) year warranty commencing on the substantial date of completion for the project provided that the warranty, in no event, shall start later than six (6) months from the date of shipment by YKK AP America Inc.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

A. Acceptable Manufacturers:

1. YKK AP America Inc.; 101 Marietta Street NW, Suite 2100; Austell, GA 30303; Telephone: (678) 838-6000; Fax: (678) 838-6001.
2. Curtain Wall System: YKK AP YHC 300 IG Curtain Wall System.

B. Curtain Wall Framing System:

1. Description: Framing System shall be thermally improved. Horizontal and vertical members shall have a nominal face dimension of 3 inches, depth as indicated on the shop drawings. Framing system shall provide a flush glazed appearance on all sides with no protruding glass stops. Framing system shall allow inside setting of glazing infills.
2. Glazing: Manufacturer's standard EPDM glazing gaskets to inhibit water infiltration at the exterior and EPDM glazing gaskets, Dow Corning® 995 Structural Silicone Sealant with fixed stops at the interior; interior spacers/gaskets are to be silicone or silicone compatible.

2.02 MATERIALS:

A. Extrusions: ASTM B 221 (ASTM B 221M), 6063-T5 Aluminum Alloy.

B. Aluminum Sheet:

1. Painted Finish: ASTM B 209 (ASTM B 209M), 3003-H14 Aluminum Alloy, 0.080" (1.95 mm) minimum thickness.

2.03 ACCESSORIES:

A. Manufacturer's Standard Accessories:

1. Fasteners: Zinc plated steel concealed fasteners; Hardened aluminum alloys or AISI 300 series stainless steel fasteners. Joint fasteners may be concealed.
2. Sealant: Non-skinning type, AAMA 803.3.
3. Glazing: Setting blocks, edge blocks, and spacers in accordance with ASTM C 864, shore durometer hardness as recommended by manufacturer; exterior glazing silicone compatible EPDM gaskets, in accordance with ASTM C 864, designed to lock into gasket reglet, interior by means of silicone spacer and structural silicone adhesive.
4. Glazing Adhesive: Dow Corning® 995 Structural Silicone.

2.04 RELATED MATERIALS (SPECIFIED IN OTHER SECTIONS):

A. Glass: Refer to Division 8 Glass and Glazing Section for glass materials.

2.05 FABRICATION:

A. Shop Assembly: Fabricate and assemble units with joints only at intersection of aluminum members with uniform hairline joints; rigidly secure, and sealed in accordance with manufacturer's recommendations.

1. Hardware: Drill and cut to template for hardware. Reinforce frames and door stiles to receive hardware in accordance with manufacturer's recommendations.
2. Welding: Conceal welds on aluminum members in accordance with AWS recommendations or methods recommended by manufacturer. Members showing welding bloom or discoloration on finish or material distortion will be rejected.

2.06 FINISHES AND COLORS:

- A. Anodized Finishing: Prepare aluminum surfaces for specified finish; apply shop finish in accordance with the following:
 - 1. Type Factory applied two-coat 70% Kynar resin by Arkema or 70% Hylar resin by Solvay Solexis, fluoropolymer based coating system, Polyvinylidene Fluoride (PVF-2), applied in accordance with YKK AP procedures and meeting AAMA 2605 specifications.
 - 2. Colors: Classic Bronze; UC109850.
- B. Finishes Testing:
 - 1. Apply 0.5% solution NaOH, sodium hydroxide, to small area of finished sample area; leave in place for sixty minutes; lightly wipe off NaOH; Do not clean area further.
 - 2. Submit samples with test area noted on each sample.

PART 3 - EXECUTION:

3.01 MANUFACTURER'S INSTRUCTIONS / RECOMMENDATIONS:

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, installation instructions, and product carton instructions. The latest installation instructions are available at www.ykkap.com.

3.02 EXAMINATION:

- A. Site Verification of Conditions: Verify conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.

3.03 PREPARATION:

- A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.04 INSTALLATION:

- A. General: Install manufacturer's system in accordance with shop drawings, and within specified tolerances.
 - 1. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials using nylon pads or bituminous coating.
 - 2. Shim and brace aluminum system before anchoring to structure.
 - 3. Verify curtain wall system allows water entering system to be collected in gutters and wept to exterior. Verify weep holes are open, and metal joints are sealed in accordance with manufacturers installation instructions.
 - 4. Seal metal to metal curtain wall system joints using sealant recommended by system manufacturer.

3.05 FIELD QUALITY CONTROL:

- A. Manufacturer's Field Services: Provide manufacturer's field service consisting of site visit for inspection of product installation in accordance with manufacturer's instructions.
 - B. Field Test: Conduct field test to determine watertightness of curtain wall system. Conduct test in accordance with AAMA 501.2.
- 3.06 ADJUSTING AND CLEANING:
- A. Adjusting: Adjust swing doors for operation in accordance with manufacturer's recommendations.
 - B. Cleaning: The General Contractor shall clean installed products in accordance with manufacturer's instructions prior to owner's acceptance and remove construction debris from project site. Legally dispose of debris.
 - C. Protection: The General Contractor shall protect the installed product's finish surfaces from damage during construction.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK:

- A. Definition: "Door Hardware" includes items known commercially as finish hardware which are required for swinging, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.
- B. Extent of door hardware required is indicated on drawings and in schedules.
- C. Types of door hardware required include, but are not limited to, the following:
 - 1. Hinges.
 - 2. Lock cylinders and keys.
 - 3. Lock and latch sets.
 - 4. Push/Pull units.
 - 5. Closers.
 - 6. Misc. door control devices.
 - 7. Door trim units.
 - 8. Protection plates.
 - 9. Sound stripping for interior doors.
 - 10. Door sweeps/ door bottoms.
 - 11. Silencers.

1.03 RELATED WORK:

- A. Related Work specified elsewhere that should be examined for its effect upon this section:
 - 1. Section 08 1113 – Hollow Metal Doors & Frames.
 - 2. Section 08 1416 – Flush Wood Doors.
 - 3. Section 08 4113 – Aluminum-Framed Entrances & Storefronts
 - 4. Section 08 8117 – Fire-Rated Glass & Framing System.

5. Division 23 – Mechanical.

6. Division 26 – Electrical.

1.04 QUALITY ASSURANCE:

- A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Supplier Qualifications: Door hardware supplier with warehousing facilities within 120 miles of the Project's vicinity and who is or employs a qualified Architectural Hardware Consultant (AHC), who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
- C. Hardware Consultant Qualifications: A person who is an Architectural Hardware Consultant (AHC) who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- E. Keying Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings." Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Address for delivery of keys.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings." Review methods and procedures related to electrified door hardware including, but not limited to, the following:
 - 1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 - 2. Review sequence of operation for each type of electrified door hardware.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review required testing, inspecting, and certifying procedures.
 - 5. Other requirements and agenda items not listed in Division 1 Section "Project Meetings" to suit Project.

1.05 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for each item of hardware in accordance with Division-1 section "Submittal Procedure". Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.
 - B. Hardware Schedule: Submit final hardware schedule in manner indicated below. Coordinate hardware with doors, frames and related work to ensure proper size, thickness, hand, function and finish of hardware.
 - 1. Final Hardware Schedule Content: Based on door hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.
 - 2. Submittal Sequence: Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames), which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of hardware schedule.
 - 3. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
 - C. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work to confirm that adequate provisions are made for proper location and installation of hardware.
- 1.06 PRODUCT HANDLING:
- A. Tag each item or package separately, with identification related to final hardware schedules, and includes basic installation instructions with each item or package.
 - B. Packaging of hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

- C. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct. Hardware supplier and Contractor are to jointly check in the hardware at the jobsite. Contractor to provide secure lock up for the hardware.
- D. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

PART 2 - PRODUCTS:

2.01 SCHEDULED HARDWARE:

- A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of door hardware is indicated in the Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following:
 - 1. Manufacturer's Product Designations: One manufacturer is listed for each hardware type required. An asterisk (*) after a manufacturers name indicates whose product designation is used in the Hardware Schedule for purposes of establishing minimum requirements. Provide the product designated.

2.02 MATERIALS AND FABRICATION:

- A. Hand of Door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- B. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except as otherwise acceptable to Architect.
 - 1. Manufacturer's identification will be permitted on rim of lock cylinders only.
- C. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI A 156 series standard for each type hardware item and with ANSI A 156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated.
- D. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware, which has been prepared for self-tapping sheet metal screws, except, as specifically indicated.
- E. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws, except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
- F. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts or installation where bolt head or nut on opposite face is exposed in other work, except

where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

- G. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.03 HINGES, BUTTS:

- A. Screws: Furnish Phillips flat-head all-purpose or machine screws for installation of units except furnish Phillips flat-head wood screws for installation of units into wood. Finish screw head to match surface of hinges.
- B. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - 1. Steel Hinges: Steel pins.
 - 2. Out-swing Corridor Doors: Non-removable pins (NRP).
 - 3. Interior Doors: Non-rising pins.
 - 4. Tips: Flat button and matching plug, finished to match leaves.
 - 5. Number of Hinges: Provide number of hinges indicated, but not less than 3 hinges per door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.
 - 6. Size: Size hinges in accordance with the specified manufacturer's published recommendations.

2.04 HINGES, CONTINUOUS:

- A. Continuous gear hinges to be manufactured of extruded 6063-T6 aluminum alloy with anodized finish, or factory painted finish as scheduled.
- B. All hinges are to be manufactured to template. Uncut hinges shall be non-handed and shall be a pinless assembly of three interlocking extrusions applied to the full height of the door and frame without mortising.
- C. Vertical door loads shall be carried on chemically lubricated polyester thrust bearings. The door and frame leaves shall be continually geared together for the entire hinge length and secured with a full cover channel. Hinge to operate to a full 180o.
- D. Hinges to be milled, anodized and assembled in matching pairs. Fasteners supplied shall be 410 stainless steel, plated and hardened.
- E. Provide UL listed continuous hinges at fire doors. Continuous hinges at fire doors shall meet the required ratings without the use of auxiliary fused pins or studs.
- F. Screws: Furnish Phillips flat-head all-purpose or machine screws for installation of units except furnish Phillips flat-head wood screws for installation of units into wood. Finish screw head to match surface of hinges.

2.05 LOCK CYLINDERS AND KEYING:

- A. Review the system with the Owner and provide the type required (master, grandmaster or great grandmaster), to match existing Corbin/Russwin system, 981 Series keyway. Coordinate interchangeable cores with A-N-J Locksmith in Cumming, GA.
 - B. Equip locks with cylinders for interchangeable-core type pin tumbler inserts. Furnish only temporary inserts for the construction period, and remove these when directed.
 - C. Furnish final cores and keys for installation by Owner.
 - D. All keys shall be marked per owner specifications.
 - E. All locks shall be grandmaster keyed and master keyed to the specifications of the Owner. All keys shall be shipped directly to the Owner only.
 - F. Key Material: Provide keys of nickel silver only.
 - G. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.
 - H. Provide complete cross index system set up by key control manufacturer and place keys on markers and hooks in the cabinet as determined by the final key schedule.
 - I. Provide hinged-panel type cabinet, for wall mounting.
- 2.06 LOCKS AND LATCHES:
- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.
 - B. Lock Throw: Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
 - 1. Provide 1/2" minimum throw of latch and deadbolt.
 - C. Provide extra heavy duty cylindrical locks as scheduled. Corbin/Russwin CL series, NZD lever /rose design. Backset: 2-3/4".
- 2.07 WEATHERSTRIPPING:
- A. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, sizes and profiles scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.
 - B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
 - C. Weatherstripping at Jambs and Heads:
 - 1. Provide bumper-type resilient insert and metal retainer strips, surface-applied, unless shown as mortised or semi-mortised, at following metal, finish and resilient bumper materials.

- a. Extruded aluminum with color anodized finish as selected by Architect from manufacturer's standard color range; 0.062" minimum thickness of main walls and flanges.
- b. Closed-cell sponge neoprene insert, conforming to MIL R 6130A Type II, Grade C, 3/16" x 5/8".

2.08 THRESHOLDS:

- A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size and profile as schedule.

2.09 CLOSERS AND DOOR CONTROL DEVICES:

- A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.
- B. Closer shall have cast iron cylinders and separate adjustments for back check, general and latch speed.

2.10 DOOR TRIM UNITS:

- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units. (Kick plates and similar units) either machine screws or self-tapping screws.
- B. Fabricate protection plates (kick or mop) not more than 1-1/2" less than door width on stop side and not more than 1/2" less than door width on pull side, x 10" high on the push side and 4" high on the pull side. Armor plates are to be 36" in height.
 - 1. Metal Plates: Stainless steel, .050" (U.S. 18 ga).

2.11 STOPS:

- A. Provide gray resilient parts for exposed bumpers.

2.12 HARDWARE FINISHES:

- A. Provide matching finishes for hardware units at each door or opening to the greatest extent possible and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.
- B. Provide finishes which match those established by BHMA.
- C. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

Hinges (Exterior)	613 (US10B) Oil Rubbed Bronze
Hinges (Interior wood doors)	652 (US26D) Satin Chrome Plated Steel
Continuous Hinges	628 (US28) Clear Anodized Aluminum
Continuous Hinges (Exterior)	Dark Bronze
Flush Bolts	626 (US26D) Satin Chrome Plated
Locks	626 (US26D) Satin Chrome Plated
Locks (Exterior)	613 (US10B) Oil Rubbed Bronze
Door Closers	paint to match adjacent hardware
Door Closers (Exterior & Stair)	613 (US10B) Oil Rubbed Bronze
Push Plates	630 (US32D) Satin Stainless Steel
Pull Plates	630 (US32D) Satin Stainless Steel
Protective Plates	630 (US32D) Satin Stainless Steel
Protective Plats (Exterior)	613 (US10B) Oil Rubbed Bronze
Door Stops - Floor	626 (US26D) Satin Chrome Plated
Door Stops – Wall	630 (US32D) Satin Stainless Steel
Overhead Holders	630 (US32D) Satin Stainless Steel
Weatherstripping	628 (US28) Clear Anodized Aluminum
Weatherstripping (Exterior)	Dark Bronze
Thresholds	627 (US27) Mill Aluminum
Thresholds (Exterior)	Dark Bronze

PART 3 - EXECUTION:

3.01 INSTALLATION:

A. Mount hardware units at heights indicated below:

1. Mounting Heights (Finished floor to item center line).

- a. Lever handles - 36"
 - b. Pulls - 38"
 - c. Push Plates- 41"
 - d. Other - NBHA Standards.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces, which are later to be painted or finished in another way, coordinate removal, storage and reinstallation of hardware with finishing work specified in the Division-9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.
- C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units, which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds in full bed of butyl-rubber sealant.
- F. The Contractor shall furnish a certificate executed by a representative of the manufacturer of the door closers that all closers have been inspected and adjusted, are operating as designed and have been installed in accordance with the manufacturer's instructions.
- 3.02 ADJUST AND CLEAN:
- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately 6 months after the acceptance of hardware in each area, the installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and readjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items that have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

PART 4 - HARDWARE MANUFACTURERS:

A. SCHEDULE OF MANUFACTURERS:

<u>PRODUCT</u>	<u>MANUFACTURER</u>
Hinges	Hager
	Ives
	PBB*
Continuous Hinges	Markar
	PBB
	Select Products*
Locksets	Corbin/Ruswin*
	PDQ
	Schlage
Exit Devices	PDQ* (lever to match locksets)
	Precision
	Von Duprin
Cylinders	Corbin/Ruswin* (to match existing)
Electric Strikes	Dynalock
	SDC
	SDC
Door Position Switches	Sentrol
Closers	LCN
	PDQ*

Push, Pulls, Push-Pulls sets, Kick Plates & Mop Plates	Burns*
	Hiawatha
	Trimco
Lock Guards, Flushbolts, Wall & Floor Stops	Burns*
	Hiawatha
	Trimco
Overhead Stops	ABH*
	Rixson
	Glynn Johnson
Door Strip, Door Sweep & Perimeter Seal	Legacy
	National Guard Products*
	Reese
Silencers	Burns*
	Ives
	Deutscher & Daughter
Thresholds	Legacy
	National Guard Products*
	Reese
Auto operators/actuators	Detex
	SDC*

PART 5 - DOOR HARDWARE SCHEDULE:

SECTION 08 80 00

GLAZING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Extent of glazing work is indicated on drawings and schedules.
- B. Types of work in this section include glazing for:
 - 1. Storefront construction.
 - 2. Entrances and other doors, not indicated as pre-glazed.
 - 3. Window units, not indicated as pre-glazed.
- C. Related Sections:
 - 1. Section 07 9200 – Joint Sealants.
 - 2. Section 08 1113 – Hollow Metal Doors & Frames.
 - 3. Section 08 1416 – Flush Wood Doors.
 - 4. Section 08 4113 – Aluminum-Framed Entrances & Storefronts.
 - 5. Section 08 8700 – Glazing Surface Films.
 - 6. Section 08 8813 – Fire Rated Glass.

1.03 SYSTEM DESCRIPTION:

- A. Provide glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.
 - 1. Deterioration of insulating glass is defined as failure of hermetic seal due to other causes than breakage which results in intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coating, if any, resulting from seal failure, and any other visual evidence of seal failure or performance.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for each glazing material and fabricated glass product required, including installation and maintenance instructions.

- B. Samples: Submit, for verification purposes, 12” square samples of each type of glass indicated except for clear single pane units, and 12” long samples of each color required (except black) for each type of sealant or gasket exposed to wire. Install sealant or gasket sample between two strips of material representative of adjoining framing system in color.
 - C. Certificate: Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for project comply with requirements.
 - 1. Separate certification will not be required for glazing materials bearing manufacturer’s permanent labels designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.
 - D. Compatibility and Adhesion Test Report: Submit statement from sealant manufacturer indicating that glass and glazing materials have been tested for compatibility and adhesion with glazing sealants and interpreting test results relative to material performance, including recommendations for primers and substrate preparation needed to obtain adhesion.
- 1.05 QUALITY ASSURANCE:
- A. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) “Glazing Manual” and “Sealant Manual” except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.
 - B. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of CPSC16 CFR Part 1201 for category II materials.
 - C. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component pane of units with appropriate certification label of one of inspecting and testing organization indicated below:
 - 1. Insulating Glass Certification Council (IGCC).
 - 2. Associated Laboratories, Inc. (ALI).
 - D. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
- A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer’s directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation of temperature changes, of direct exposure to sun, and from other causes.
 - 1. Where insulating glass units will be exposed to substantial altitude changes, avoid hermetic seal ruptures by complying with insulating glass fabricator’s recommendations for venting and sealing.

1.07 PROJECT CONDITIONS:

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.

1.08 WARRANTY:

- A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.
- B. Manufacturer's Special Project Warranty on Insulating Glass: Provide written warranty signed by manufacturer of insulating glass agreeing to furnish f.o.b. point of manufacture, freight allowed project site, within specified warranty period indicated below, replacements for those insulating glass units developing manufacturing defects. Manufacturing defects are defined as failure of hermetic seal of air space (beyond that due to glass breakage) as evidenced by intrusion of dirt or moisture, internal condensation or fogging, deterioration of protected internal glass coatings, if any, and other visual indications of seal failure or performance; provided the manufacturer's instructions for handling, installing, protecting and maintaining units have been complied with during the warranty period.
 - 1. Warranty Period: Manufacturer's standard, but not less than 10 years after date of Substantial Completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. AFG Industries, Inc.
 - 2. Cardinal Glass Industries.
 - 3. Guardian Industries Corp.
 - 4. Oldcastle Glass
 - 5. Pilkington Sales (North America) Limited.
 - 6. Technical Glass Products.
 - 7. Vitro Architectural Glass.
 - 8. Viracon, Inc.
- B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 GLASS PRODUCTS, GENERAL:

- A. Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.
- B. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish and pattern.
- C. Laminated Glass Standard: Provide laminated architectural safety glass, which complies with ASTM C1172 requirements.
- D. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

2.03 PRIMARY GLASS PRODUCTS:

- A. Clear Float Glass: Type I (transparent glass, flat), Class 1 (Clear), Quality q3 (glazing select), 1/4" thick.
- B. Tinted Float Glass: Type I (transparent glass, flat), Class 2, (tinted heat absorbing and light reducing), Quality q3 (glazing select), 1/4" thick, and as follows:
 - 1. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient and visible reflectance.
- C. Wired Glass: Type II (pattern and wired glass, flat), Class 1 (translucent), Quality q8 (glazing); complying with ANSI Z97.1; 1/4" thick; of form and mesh pattern indicated below:
 - 1. Polished Wire Glass: Form 1 (wired, polished both sides), mesh M2 (square).

2.04 HEAT-TREATED GLASS PRODUCTS:

- A. Manufacturing Process: Manufacture heat-treated glass as follows:
 - 1. By vertical (tong-held) or horizontal (roller hearth) process, at manufacturer's option, except provide horizontal process where indicated as "tongless" or "free of tong marks".
- B. Uncoated Clear Heat-Treated Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 1/4" thick kind as indicated below:
 - 1. Kind FT (fully tempered) where indicated or as required by local codes.
- C. Uncoated Tinted Heat-Treated Float Glass: Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 2 (tinted heat absorbing and light reducing), Quality q3 (glazing select), with tint color and performance characteristics for 1/4" thick glass matching those indicated for non-heat-treated tinted float glass; kind as indicated below:
 - 1. Kind FT (fully tempered) where indicated or as required by local codes.

2.05 SEALED INSULATING GLASS UNITS:

- A. General: Provide preassembled units consisting of organically sealed panes of glass enclosing a hermetically sealed dehydrated air space and complying with ASTM E 2190 for performance classification indicated as well as with other requirements specified for glass characteristics, air spaces, sealing system, sealant, spacer material, corner design and desiccant.
 - 1. For properties of individual glass panes making up units, refer to product requirements specified elsewhere in this section applicable to types, classes, kinds and conditions of glass products indicated.
 - 2. Provide heat-treated panes for all units.
 - a. U-Values indicated are expressed in the number of BTU's per hour per sq. ft. per degree F difference.
 - 3. Performance Classification per ASTM E 2190: Class A.
 - a. Thickness of Each Pane: 1/4"
 - b. Air Space Thickness: 1/2"
 - c. Sealing System: Manufacturer's standard.
 - d. Spacer Material: Manufacturer's standard metal.
 - e. Desiccant: Manufacturer's standard; either molecular sieve or silica gel or blend of both
 - f. Corner Construction: Manufacturer's standard corner construction.
 - B. Coated Insulating Glass Units: Manufacturer's standard units complying with the following requirements.
 - 1. Exterior Pane: Basis of Design: Vitro Architectural Glass "Solarban 60, Solar Control, Low-E (2) Solarbronze" tinted float glass.
 - 2. Interior Pane of Glass: Clear float glass.
 - 3. Performance Characteristics: Visible light transmittance of 42 percent, light to solar gain of 1.50, winter nighttime U-value of 0.29, solar heat gain coefficient of 0.28 and outdoor reflectance of 7% visible light.
- 2.06 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES:
- A. General: Provide products of type indicated and complying with the following requirements:
 - 1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience. Glazing installations must be watertight.
 - 2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.

3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
 4. Colors: Provide color of exposed sealants as selected by Architect from manufacturer's standard colors.
- B. Two-Part Polysulfide Glazing Sealant: Type M; Grade NS; Class 25; Uses NT, M, G, A, and as applicable to uses indicated, O.
- C. One-Part Acid-Curing Silicone Glazing Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to uses indicated, O.
- D. One-Part Non-Acid-Curing Silicone Glazing Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to uses indicated, O; and complying with the following requirements modulus and additional joint movement capability.
1. Medium Modulus: Tensile strength of not less than 45 nor more than 75 psi at 100 percent elongation when tested per ASTM D 412 after 14 days at 77° F (20° C) and 50 percent relative humidity.
 2. Additional capability, when tested per ASTM C 719 for adhesion and cohesion under maximum cyclic movement, to withstand the following percentage increase and decrease of joint width, as measured at time of application, and remain in compliance with other requirements of ASTM C 920.
 - a. 50 percent.
- E. Preformed Butyl-Polyisobutylene Glazing Tape: Provide manufacturer's standard solvent-free butyl-polyisobutylene formulation with a solids content of 100 percent; complying with AAMA A 804.1; in extruded tape form; non-staining and non-migrating in contact with nonporous surfaces; packaged on rolls with a release paper on one side; with or without continuous spacer rod as recommended by manufacturers of tape and glass for application indicated.
- F. Products: Subject to compliance with requirements, provide one of the following:
1. Two-Part Polysulfide Glazing Sealant:
 - a. "Chem-Calk 200"; Bostik Construction Products Div.
 - b. "Synthacalk GC-5"; Pecora Corp.
 2. One-Part Acid-Curing Silicone Glazing Sealant:
 - a. "Chem-Calk 200"; Bostik Construction Products Div.
 - b. "Dow Corning 999"; Dow Corning Corp.
 - c. "863"; Pecora Corp.
 - d. "Proglaze"; Tremco, Inc.
 3. One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:

- a. “Dow Corning 795”; Dow Corning Corp.
 - b. “Spectrun 2”; Tremco, Inc.
- 4. Preformed Butyl-Polyisobutylene Glazing Tape without Spacer Rod:
 - a. “Chem-Tape 40”; Bostik Construction Products Div.
 - b. “Extru-Seal”; Pecora Corp.
 - c. “Tremco 440 Tape”; Tremco, Inc.
- 5. Preformed Butyl-Polyisobutylene Glazing Tape With Spacer Rod:
 - a. “Chem-Tape 60”; Bostik Construction Products Div.
 - b. “Shim-Seal”; Pecora Corp.
 - c. “Pre-shimmed Tremco 440 Tape”; Tremco, Inc.

2.07 GLAZING GASKETS:

- A. Lock-strip Gaskets: Neoprene extrusions of size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542; black.
- B. Dense Elastomeric Compression Seal Gaskets: Molded or extruded gaskets of material indicated below, complying with ASTM C 864, of profile and hardness required to maintain watertight seal:
 - 1. Neoprene.
 - 2. EPDM.
 - 3. Thermoplastic polyolefin rubber.
 - 4. Any material indicated above.
- C. Cellular Elastomeric Preformed Gaskets: Extruded or molded closed cell, integral-skinned neoprene of profile and hardness required to maintain watertight seal; complying with ASTM C 509, Type II; black.
- D. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Manufacturers of Lock-Strip Gasket:
 - a. Cadillac Rubber & Plastics, Inc.
 - b. Maloney Precision Products Co.
 - c. The Standard Products Co.
 - 2. Manufacturers of Preformed Gaskets:
 - a. D.S. Brown Co.

- b. Maloney Precision Products Co.
- c. Tremco, Inc.

2.08 MISCELLANEOUS GLAZING MATERIALS:

- A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
- D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.
- E. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.
- F. Compressible Filler Rods: Closed-cell or water-proof jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient with 5-10 psi compression strength for 25 percent deflection.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face of edge clearances; and for effective sealing of joinery. Obtain Glazier's written report-listing conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.02 GLAZING, GENERAL:

- A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.
- B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.
- C. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge, which would occur in vicinity of setting blocks so that these are located at top of opening. remove from project and dispose of glass units

with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.

3.03 GLAZING:

- A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.
- B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height) except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
- C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
- D. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
- E. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.
- F. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- G. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.
- H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.
- I. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- J. Lock-Strip Gasket Glazing: Comply with ASTM C716 and gasket manufacturer's printed recommendations. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.04 PROTECTION AND CLEANING:

- A. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.
- B. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less often than once a month, for build-up of dirt, scum alkali deposits or staining. When examination reveals presence of these forms of residue, remove by method recommended by glass manufacturer.

- C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.
- D. Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY:

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete.
2. Section 04 20 00 – Unit Masonry Assemblies.
3. Division 5 – Metals.
4. Section 06 10 00 – Rough Carpentry.
5. Section 07 21 00 – Thermal Insulation.
6. Section 07 92 00 – Joint Sealants.
7. Section 08 31 13 – Access Doors & Panels.
8. Section 09 20 00 – Gypsum Board.
9. Section 09 50 00 – Acoustical Panel Ceilings.
10. Division 21 – Fire Suppression.
11. Division 22 – Plumbing.
12. Division 23 – Mechanical.
13. Division 26 – Electrical.
14. Division 27 – Communications.
15. Division 28 – Electronic Safety & Security.

1.03 SUBMITTALS:

- A. Product Data: For each type of product.

- B. Evaluation Reports: For dimpled steel studs and runners and firestop tracks, from ICC-ES.

1.04 QUALITY ASSURANCE:

- A. Contractor shall provide effective, full time quality control over all fabrication and erection complying with the pertinent codes and regulations of government agencies having jurisdiction. Conduct pre-installation meeting to verify project requirements, substrate conditions, and manufacturer's installation instructions.

1.05 DELIVERY, STORAGE, AND HANDLING:

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI's "Code of Standard Practice".

PART 2 - PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Products specified as standard of quality are indicated in specific material articles.
- B. Products of manufacturers listed below meeting indicated standard and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to approval of product list and samples.
- C. Section 01 6000 - Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 PERFORMANCE REQUIREMENTS:

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- B. Design framing systems in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.
- C. Design loads: 5 PSF minimum as required by the International Building Code.
- D. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection of 4 inches.

2.03 FRAMING SYSTEMS:

- A. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

- B. Framing Members, General: Comply with ASTM C645-09 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C645-09 requirements for metal unless otherwise indicated.
 2. Comply with ASTM C645-09; roll-formed from hot-dipped galvanized steel; complying with ASTM A1003/A1003M and ASTM A653/A653M G40 (Z120) or equivalent corrosion resistant coating. A40 galvanized products are not acceptable.
- C. Steel Studs and Runners: ASTM C645-09.
1. Non-structural Studs: Cold-formed galvanized steel C-studs, Dietrich ProSTUD™ drywall studs as per ASTM C645-09 for conditions indicated below:
 - a. Flange Size: 1 1/4 inch (32mm).
 - b. Web Depth: As indicated on drawings.
 - c. Member Description: ProSTUD™ 20 (20ga equivalent drywall stud) 65ksi, unless indicated otherwise.
 - 1) Minimum Thickness: 0.0220 inches (0.5588mm).
 - 2) Minimum Design Thickness: 0.0232 inches (0.5893mm).
 - d. Comparable product by one of the following are acceptable:
 - 1) Marino WARE.
 - 2) USG Corporation.
 2. Non-structural Track: Cold-Formed galvanized steel runner tracks, Dietrich ProTRAK™ drywall track, in conformance with ASTM C-645-09 for conditions indicated below:
 - a. Flange Size: 1-1/4 inch (32 mm).
 - b. Web Depth: Track web to match stud web size.
 - c. Minimum Material Thickness: Track thickness to match wall stud thickness or as per design.
- D. Slip-Type Head Joints: Where indicated, provide the following:
1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
 2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Dietrich Metal Framing; SLP-TRK Slotted Deflection Track by Brady Innovations, or a comparable product by one of the following:

- 1) Marino WARE.
 - 2) USG Corporation.
- E. Channel Bridging and Bracing: Steel, 0.0538-inch (1.37-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Dietrich Metal Framing; Spazzer 9200 Bridging and Spacing Bar, or a comparable product by one of the following:
 - a. Marino WARE.
 - b. USG Corporation.
 2. Depth: 7/8 inch by 7/8 inch by 50 inches (22.2 mm by 22.2 mm by 1270 mm).
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.0296 inch (0.75 mm).
 2. Depth: 7/8 inch (22.2 mm).
- G. Headers and Jambs: Manufacturer's proprietary shape used to form header beams and jambs, columns or posts, of web depths indicated, unpunched, with stiffened flanges and as follows:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Dietrich Metal Framing; Heavy Duty Studs - HDS and Header Bracket – HDSC, ProX Header by Brady Innovations, or a comparable product by one of the following:
 - a. Marino WARE.
 - b. USG Corporation.
 2. Minimum Base Metal Thickness: 0.0966 inch (2.45 mm).
 3. Web and Flange Widths, Type HDS: 6 by 3 by 2-1/4 by 3/4 inch (152 by 76.2 by 57.2 by 19.1 mm).
 4. Web and Flange Widths, Type HDSC: 5-7/8 by 3-1/16 by 2 inches (149 by 77.8 by 50.8 mm).
- 2.04 SUSPENSION SYSTEMS:
- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
 - B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
 - C. Carrying Channels: Cold-formed, commercial-steel sheet with a base-metal thickness of 0.0538-inch (1.37-mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 1. Depth: 2 inches (51 mm).

D. Furring Channels (Furring Members):

1. Cold-Formed Channels: 0.0538-inch (1.37-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C645-09.
3. Non-structural Studs: Cold-formed galvanized steel C-studs, Dietrich ProSTUD™ drywall studs as per ASTM C645-09 for conditions indicated below:
 - a. Flange Size: 1 1/4 inch (32mm)
 - b. Web Depth: 6 inches (152 mm).
 - c. Member Description: ProSTUD™ 20 (20ga equivalent drywall stud) 65ksi, unless indicated otherwise.
 - 1) Minimum Thickness: 0.0220 inches (0.5588mm).
 - 2) Minimum Design Thickness: 0.0232 inches (0.5893mm)
4. Non-structural Track: Cold-Formed galvanized steel runner tracks, Dietrich ProTRAK™ drywall track, in conformance with ASTM C-645-09 for conditions indicated below:
 - a. Flange Size: 1-1/4 inch (32 mm).
 - b. Web Depth: Track web to match stud web size.
 - c. Minimum Material Thickness: Track thickness to match wall stud thickness or as per design.
5. Traditional flat material:
 - a. Minimum Base-Metal Thickness: 0.0296 inch (0.7520 mm).
6. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - a. Minimum Base-Metal Thickness: 0.0296 inch (0.75 mm).

E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.05 AUXILIARY MATERIALS:

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.03 INSTALLATION, GENERAL:

- A. Installation Standard: ASTM C 754:
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING FRAMED ASSEMBLIES:

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
 2. Multilayer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

- C. Install studs so flanges within framing system point in same direction.
 - D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 - F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.
- 3.05 INSTALLING SUSPENSION SYSTEMS:
- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches (1219 mm) o.c.
 - 2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
 - 3. Furring Channels (Furring Members): 24 inches (610 mm) o.c.
 - B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
 - C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

- a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
- 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
- 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
- 4. Do not attach hangers to steel roof deck.
- 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
- 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
- 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION SECTION 09 30 13

CERAMIC TILE

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to this section.

1.02 SUMMARY:

- A. This section includes the following:

1. Ceramic mosaic tile.
2. Porcelain tile.
3. Glazed wall tile.
4. Stone thresholds.
5. Tile backing panels.
6. Waterproof membrane.
7. Crack isolation membrane.
8. Metal edge strips.

- B. Related Sections:

1. Section 03 3000 – Cast-In-Place Concrete.
2. Section 06 4023 – Interior Architectural Woodwork.
3. Section 07 9200 - Joint Sealants.
4. Section 09 2000 – Gypsum Board.
5. Section 10 2113 – Toilet Compartments.
6. Section 10 2800 – Toilet & Bath Accessories.
7. Section 10 2813 – Mirror Units.

1.03 SUBMITTALS:

- A. General: Submit the following in accordance with conditions of Contract and Division 1 specification section.

- B. Product Data: Submit for each type of product specified.
 - C. Shop drawings indicating tile patterns and locations and widths of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
 - 1. Locate precisely each joint and crack in tile substrate by measuring, record measurements on shop drawings, and coordinate them with tile joint locations in consultation with Architect.
 - D. Samples for Verification Purposes of each item listed below, prepared on samples of size and construction indicated, products involve color and texture variations, in sets showing full range of variations expected.
 - 1. Each type and composition of tile, and for each color and finish required, at least 12" square. For ceramic mosaic tile in color blend patterns, provide samples of each color blend.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
 - 3. Full-size units of each type of trim and accessory for each color and finish required.
 - 4. Stone thresholds in 6" lengths.
 - E. Submit proof of warranty.
 - F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.
- 1.04 QUALITY ASSURANCE:
- A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
 - B. Single-Source Responsibility Full System Installation Materials: Obtain all installation materials from a single source manufacturer supplier to be in compliance with manufacturers Full System Warranty.
 - C. Installer Qualifications:
 - 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractor's Association of America.
 - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
 - 3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.
 - D. Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Construction Progress Documentation".

- E. Mockups: Build mockups to verify selections made under Submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of each type of floor tile installation.
 - 2. Building mockup of each type of wall tile installation.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.05 DELIVERY, STORAGE AND HANDLING:
 - A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements of ANSI A137.1 for labeling sealed tile packages.
 - B. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.
- 1.06 PROJECT CONDITIONS:
 - A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
 - B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide build-up.
 - C. Maintain temperatures at 50°F (10°C) or more in tiled areas during installation and 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.
 - D. Comply with installation materials manufacturer's recommended procedures for hot or cold weather.
- 1.07 WARRANTY:
 - A. The Contractor warrants the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of ten (10) years. The manufacturer of installation materials shall provide a written ten (10) year warranty that covers materials and labor.
- 1.08 MAINTENANCE:
 - A. Submit maintenance data under provisions of Section 01 7700 – Closeout Procedures. Include cleaning methods, cleaning solutions, recommended stain removal methods and polishes and waxes recommended.
- 1.09 EXTRA MATERIALS:
 - A. Deliver extra materials to Owner. Furnish extra materials that match and are from same production runs as products installed, and that are packaged with protective covering for storage and identified with labels clearly describing contents.
 - 1. Tile and trim units: Furnish quantity of full-size units equal to 3% of amount installed for each type, composition, color, pattern and size indicated.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide products from the following:
 - 1. Ceramic Tile:
 - a. Daltile.
 - 2. Metal Edge Strips:
 - a. Schluter Systems L.P.
 - 3. Full System Installation Materials:
 - a. Custom Building Products.
- B. Section 01 6000 - Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 PRODUCTS, GENERAL:

- A. ANSI Ceramic Tile Standard: Provide "standard-grade" tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Colors, Textures and Patterns: For tile and other products requiring selection of colors, surface textures or other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Provide selections made by Owner/Architect from manufacturer's full range of standard colors, textures and patterns for products of type indicated.
 - 2. Provide tile trim and accessories which match color and finish of adjoining flat tile.
- D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- E. Mounting: Where factory-mounted tile is required, provide back or edge-mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back-or edge-mounted tile assemblies, unless tile manufacturer specifies that this type of mounting is suitable for these kinds of use and has been successfully used on other projects.

2.03 TILE PRODUCTS:

- A. Factory-Mounted Unglazed/Glazed Ceramic Mosaic Tile:

1. Composition: Porcelain.
2. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
3. Module Size: 3 x 3 inches.
4. Thickness: 1/4 inch.
5. Face: Pattern of design indicated, with cushion edges.
6. Surface: Slip resistant, with abrasive admixture.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Finish: Mat, opaque glaze.
9. Tile Color and Pattern: Moroccan Brown, CS55.
10. Grout Color: Saddle Brown, 59.
11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: 6 x 12 inches.
 - b. External Corners for Thinset Mortar Installations: 1 x 6 inches.
 - c. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Unglazed Porcelain Tile:

1. Certification: Tile certified by the Porcelain Tile Certification Agency.
2. Face Size:
 - a. Floor: 6 x 6 inches.
 - b. Wall: 12 x 12 inches.
3. Face Size Variation: Rectified.
4. Thickness: 5/16th inch.
5. Face: Plain with square or cushion edge..
6. Dynamic Coefficient of Friction: Not less than 0.42.
7. Tile Color and Pattern:
 - a. Floor: Moroccan Brown, CS55.
 - b. Wall: Egyptian Beige, CS50.

8. Grout Color:
 - a. Floor: Saddle Brown, 59.
 - b. Wall: Light Smoke, 145.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Base Cove: Surface bullnose, module size same as adjoining flat tile.
 - b. External Corners: Surface bullnose, module size same as adjoining flat tile.
 - c. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

2.04 THRESHOLDS:

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503/ C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.
 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.05 TILE BACKING PANELS:

- A. Cementitious Backer Units (for use at showers and areas subject to wetting): ANSI A118.9 or ASTM C 1325, Type A.
 1. Product: Subject to compliance with requirements, provide one of the following:
 - a. Custom Building Products; WonderBoard.
 - b. USG Corporation; Durock Cement Board.
 2. Thickness: 1/2 inch.

2.06 WATERPROOF MEMBRANE:

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
 1. Products: Subject to compliance with requirements, provide the following:

- a. Custom Building Products; RedGard Waterproofing and Crack Prevention Membrane,

2.07 CRACK ISOLATION MEMBRANE:

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane,

2.08 SETTING MATERIALS:

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
 - 1. Manufacturers: Subject to compliance with requirements, provide the following:
 - a. Custom Building Products; Speed Slope – Rapid Setting Sloping Mortar.
- B. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
 - 1. Manufacturers: Subject to compliance with requirements, provide the following:
 - a. Custom Building Products; VersaBond Professional Thin-Set Mortar.
 - 2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 - 3. For wall applications, provide nonsagging mortar.

2.09 GROUT MATERIALS:

- A. High-Performance Tile Grout: ANSI A118.7.
 - 1. Manufacturers: Subject to compliance with requirements, provide the following:
 - a. Custom Building Products; Polyblend Plus Sanded Grout.
 - 2. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.

2.10 MISCELLANEOUS MATERIALS:

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, design specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. Schluter Systems L.P.
- C. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Custom Building Products; TileLab SurfaceGard Sealer.
 - 2. Grout sealers shall comply with requirements of FloorScore certification.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine substrates, areas and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
 - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installation indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION:

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1:50 (1/4 inch per foot) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so that tile units taken from one package show the same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 CERAMIC TILE INSTALLATION:

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches or larger.
 - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or build-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Layout tile work and center tile fields in both directions in each space or on each wall area. Layout tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls and trim are same size.
 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 1. Ceramic Mosaic Tile: 1/8 inch.
 2. Porcelain Tile: 1/4 inch.
- H. Layout tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, construction, and isolation joints where indicated and required. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor, unless otherwise indicated.
 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-Portland cement mortar (thinset).
 2. Do not extend waterproofing or crack isolation membrane under thresholds set in latex-Portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing or crack isolation membrane with elastomeric sealant.

- K. Metal Edge Strips: Install at locations indicated, and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
 - L. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
 - M. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-Portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.
 - N. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
 - O. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
 - P. Sound tile after setting. Replace hollow sounding units.
- 3.04 FIELD QUALITY CONTROL WATER TEST:
- A. Upon completion of work, plug drain or dam areas and fill with water. After 24 hours, inspect for leakage. Make necessary adjustments to stop leakage and retest until watertight.
- 3.05 CLEANING AND PROTECTION:
- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded or otherwise defective tile work.
 - C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensure that tile is without damage or deterioration at time of Substantial Completion.
 - 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.
 - 2. Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.
 - D. Protect membrane from pedestrian or vehicular traffic and prolonged exposure to sunlight.
- 3.06 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE:
- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F121 and ANSI A108.1A; cement mortar bed (thickset) on waterproof membrane.

- a. Ceramic Tile Type: CFT1.
 - b. Bond Coat for Cured-Bed Method: Dry-set Portland cement mortar.
 - c. Grout: High-performance sanded grout.
- 2. Ceramic Tile Installation: TCNA F125A; thinset mortar on crack isolation membrane.
 - a. Ceramic Tile Type: CFT2.
 - b. Thinset Mortar: Latex-Portland cement mortar.
 - c. Grout: High-performance sanded grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C or TCNA W224F; thinset mortar on cementitious backer units.
 - a. Ceramic Tile Type: CWT2.
 - b. Thinset Mortar: Latex-Portland cement mortar.
 - c. Grout: High-performance sanded grout.
 - 2. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
 - a. Ceramic Tile Type: CWT1.
 - b. Thinset Mortar: Latex-Portland cement mortar.
 - c. Grout: High-performance sanded grout.
- C. Shower Receptor and Wall Installations:
 - 1. Ceramic Tile Installation: TCNA B415; thinset mortar on waterproof membrane over cementitious backer units or fiber-cement backer board.
 - a. Ceramic Tile Type: CWT3.
 - b. Thinset Mortar: Latex-Portland cement mortar.
 - c. Grout: High-performance sanded grout.

END OF SECTION

SECTION 09 50 00

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.02 SUMMARY:

A. Section Includes:

1. Acoustical ceiling panels.
2. Exposed grid suspension system.
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings.

B. Related Sections:

1. Section 07 92 00 – Joint Sealants.
2. Section 09 20 00 - Gypsum Board.
3. Section 09 22 16 – Non-Structural Metal Framing.
4. Division 21 – Fire Suppression.
5. Division 23 – Mechanical.
6. Division 26 – Electrical.
7. Division 27 – Communications.

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM):

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
5. ASTM C 635 Standard Specifications for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 8. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
 9. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems.
 10. ASTM E 1264 Classification for Acoustical Ceiling Products.
 11. ASTM E 1477 Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
 12. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 13. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Material.
- B. ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality".
- 1.04 SUBMITTALS:
- A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
 - B. Samples: Minimum 6 inch x 6 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.
 - C. Shop Drawings: Layout and details of acoustical ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.
 - D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.
 - E. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance on every carton, subcontractor shall be required to send material from every production run appearing on the job to an independent or NVLAP approved laboratory for testing, at the architect's or owner's discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.
- 1.05 QUALITY ASSURANCE:
- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
 - B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
 - C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.
- 1.06 DELIVERY, STORAGE, AND HANDLING:
- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
 - B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
 - C. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.
- 1.07 PROJECT CONDITIONS:
- A. Space Enclosure:
 1. All ceiling products and suspension systems must be installed and maintained in accordance with Armstrong written installation instructions for that product in effect at the time of installation and best industry practice. Prior to installation, the ceiling product must be kept clean and dry, in an environment that is between 32°F (0°C) and 120°F (49°C) and not subject to Abnormal Conditions. Abnormal conditions include exposure to chemical fumes, vibrations, moisture from conditions such as building leaks or condensation, excessive humidity, or excessive dirt or dust buildup.
 2. HumiGuard Plus Ceilings: Installation of the products shall be carried out where the temperature is between 32°F (0° C) and 120°F (49° C). It is not necessary for the area to be enclosed or for HVAC systems to be functioning. All wet work (plastering, concrete, etc) must be complete and dry. The ceilings must be maintained to avoid excessive dirt or dust buildup that would provide a medium for microbial growth on ceiling panels. Microbial protection does not extend beyond the treated surface as received from the factory, and does not protect other materials that contact the treated surface such as supported insulation materials.
 3. HumiGuard Max Ceilings: HumiGuard Max's sag performance warranty extends to installations where the ceiling product is exposed to chemical fumes, extreme temperatures up to 120°F (49° C) (including steam up to 275°F (135° C)) and 100% RH, including standing water applications so long as the product is installed with either SS Prelude Plus, AL Prelude Plus or Prelude Plus XL Fire Guard suspension systems. For swimming pools, install only with AL Prelude Plus suspension system. For outdoor soffits, canopies, and parking garages install with Prelude XL for Exterior Applications (wind uplift should be considered).

The ceilings must be maintained to avoid excessive dirt or dust buildup that would provide a medium for microbial growth on ceiling panels. Microbial protection does not extend beyond the treated surface as received from the factory, and does not protect other materials that contact the treated surface such as supported insulation materials.

1.08 WARRANTY:

- A. Acoustical Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Acoustical Panels: Sagging and warping as a result of defects in materials or factory workmanship.
 - 2. Grid System: Rusting and manufacturer's defects.
 - 3. Acoustical Panels with BioBlock Plus or designated as inherently resistive to the growth of micro-organisms installed with Armstrong suspension systems: Visible sag and will resist the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.
- B. Warranty Period Humiguard:
 - 1. Acoustical panels: Ten (10) years from date of substantial completion.
 - 2. Grid: Ten (10) years from date of substantial completion.
 - 3. Acoustical panels and grid systems with HumiGuard Plus or HumiGuard Max performance supplied by one source manufacturer is thirty (30) years from date of substantial completion.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.09 MAINTENANCE:

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 - 1. Acoustical Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Ceiling Panels:
 - 1. USG Corporation.
- B. Suspension System:
 - 1. USG Corporation.

- C. Section 01 6000 – Product Requirements: Product selection Procedures: Substitutions: Not Permitted.

2.02 ACOUSTICAL CEILING UNITS:

A. Acoustical Panels Type ACT-1:

1. Acceptable Product: Radar, 2120.
2. Surface Texture: Lightly-textured.
3. Composition: Mineral Fiber.
4. Color: Flat White.
5. Size: 24 in x 24 in x 5/8in.
6. Edge Profile: SLT.
7. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton 0.55.
8. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton 33.
9. Flame Spread: ASTM E 84; Class A (UL).
10. Light Reflectance (LR) White Panel: ASTM E 1477; 0.83.
11. Dimensional Stability: Standard.

B. Acoustical Panels Type ACT-2:

1. Acceptable Product: Radar, 2220.
2. Surface Texture: Lightly-textured.
3. Composition: Mineral Fiber.
4. Color: Flat White.
5. Size: 24 in x 24 in x 5/8in.
6. Edge Profile: SLT.
7. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton 0.55.
8. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton 33.
9. Flame Spread: ASTM E 84; Class A (UL).
10. Light Reflectance (LR) White Panel: ASTM E 1477; 0.83.
11. Dimensional Stability: Standard.

2.03 SUSPENSION SYSTEMS:

- A. Components: All main beams and cross tees shall be commercial quality hot-dipped galvanized (galvanized steel, aluminum, or stainless steel) as per ASTM A 653. Main beams and cross tees are double-web steel construction with 15/16 IN type exposed flange design. Exposed surfaces chemically cleansed, capping pre-finished galvanized steel (aluminum or stainless steel) in baked polyester paint. Main beams and cross tees shall have rotary stitching (exception: extruded aluminum or stainless steel).
 - 1. Acceptable Product: Donn DX/DXL.
 - 2. Structural Classification: ASTM C 635 HD.
 - 3. Color: White and match the actual color of the selected ceiling tile, unless noted otherwise.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three times design load, but not less than 12 gauge.
- D. Edge Moldings and Trim: Metal or extruded aluminum of types and profiles indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations, including light fixtures, that fit type of edge detail and suspension system indicated. Provide moldings with exposed flange of the same width as exposed runner.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations. (Exception: HumiGuard Max Ceilings)

3.02 PREPARATION:

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- B. Protect surrounding work from damage.

3.03 INSTALLATION:

- A. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.
- B. Suspend main beam from overhead construction with hanger wires spaced 4'-0" on center along the length of the main runner. Install hanger wires plumb and straight.
- C. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

- D. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.
- E. Install acoustical panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.04 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage.
 - 1. Ceiling Touch-Up Paint, (Item #5760, 8oz. bottles) (Item #5761, quart size cans), "global white" latex paint should be used to hide minor scratches and nicks in the surface and to cover field tegularized edges that are exposed to view.
- C. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Div. -1 specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK:

- A. Extent of resilient flooring and accessories is shown on drawings and in schedules.

- B. Related Sections:

- 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 04 20 00 – Unit Masonry Assemblies.
 - 3. Section 06 40 23 – Interior Architectural Woodwork.
 - 4. Section 07 92 00 – Joint Sealants.
 - 5. Section 09 20 00 – Gypsum Board.
 - 6. Section 09 30 13 – Ceramic Tile.
 - 7. Section 09 65 36 – Static Control Resilient Flooring.
 - 8. Section 09 68 13 – Tile Carpeting.
 - 9. Section 09 69 00 – Access Flooring.
 - 10. Section 09 77 00 – Special Wall Surfacing.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for each type of resilient flooring and accessory.
- B. Samples for Initial Selection Purposes: Submit manufacturer's standard color charts in form of actual sections of resilient flooring, including accessories, showing full range of colors and patterns available, for each type of resilient flooring required.
- C. Samples for Verification Purposes: Submit the following samples of each type, color, and pattern of resilient flooring required, showing full-range of color and pattern variations.
 - 1. Full size tile samples.
 - 2. 2½ feet long samples of resilient flooring accessories.

- 3. Other materials as requested.
- D. Maintenance Instructions: Submit 2 copies, minimum, of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.
- 1.04 QUALITY ASSURANCE:
 - A. Manufacturer: Provide each type of resilient flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.
 - B. Product manufacturing facility to be compliant with latest ISO 9000 standard.
- 1.05 PROJECT CONDITIONS:
 - A. Maintain minimum temperature of 65°F (18°C) in spaces to receive resilient flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Subsequently, maintain minimum temperature of 55°F (13°C) in areas where work is completed.
 - B. Install resilient flooring and accessories after other finishing operations, including painting have been completed. Do not install resilient flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by resilient flooring mfr's recommended bond and moisture test.
- 1.06 WARRANTY:
 - A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Warranty Period: 5 and 20 years commencing on Date of Substantial Completion.

PART 2 - PRODUCTS:

- 2.01 ACCEPTABLE MANUFACTURERS:
 - A. Manufacturers: Subject to compliance with requirements, provide the following:
 - 1. Manufacturer of Commercial Homogeneous Tile:
 - a. Armstrong.
 - 2. Manufacturer of Rubber Wall Base and Accessories:
 - a. Roppe.
 - B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.
- 2.02 RESILIENT FLOORING COLORS AND PATTERNS:
 - A. Color:
 - 1. VCT: Field Gray, 51927.

2. LVT: Ferralite, ST265.
3. Accessories: Dolphin, 129.

B. Pattern: Provide patterns as indicated on the Drawings.

2.03 TILE FLOORING:

A. Commercial Homogeneous Tile: ASTM F 1066, Class 2, Type A; and as follows:

1. Size: 12" x 12".
2. Gauge: 1/8".
3. Flammability: Provide materials with 0.45 CRF (critical radiant flux) or higher when tested in accordance with ASTM E 648, Flooring Radiant Panel Test.
4. Smoke Density: Provide materials with smoke density of less than 450 when tested in accordance with ASTM E 662.
5. Static Load: Provide materials with static load limit of 125 psi or higher.
6. Slip Resistance: Provide materials with minimum rating for floors of > 0.60.

B. Luxury Flooring:

1. Description: A layered construction consisting of a tough, clear, rigid vinyl wear layer protecting a high-fidelity print layer on a solid vinyl backing. Protected by a diamond-infused UV-cured polyurethane finish, the wear surface is embossed with different textures to enhance each of the printed visuals. Colors are insoluble in water and resistant to cleaning agents and light.
2. Reference specification - ASTM F 1700, "Standard Specification for Solid Vinyl Tile", Class III, Type B – Embossed Surface. Meets requirements for size, squareness, thickness, thickness of wear layer, residual indentation, resistance to chemicals, resistance to light and resistance to heat.
3. Size: 9 in. x 48 in. or 6 in. x 48 in.
4. Wear layer thickness: 0.020 in.
5. Thickness: 0.100 in.

2.04 ACCESSORIES:

A. Rubber Wall Base: Provide rubber base complying with FS SS-W-40, Type I, with matching end stops and preformed or molded corner units and as follows:

1. Height: 4".
2. Thickness: 1/8" gauge.
3. Style: Standard top-set cove.
4. Finish: Matte.

- B. Resilient Edge Strips: 1/8" thick, homogeneous rubber composition, tapered or bull nose edge, color to match flooring, or as selected by Architect from standard colors available, not less than 1" wide.
- C. Resilient Stair Treads: Provide treads where indicated, consisting of single-piece units for width of stair treads, or equal-length units if tread width exceeds available manufactured lengths.
 - 1. Provide rubber stair tread units complying with ASTM F 2169, Type TS, Class 2 (patterned), Group 1 (abrasive), and as follows:
 - a. Provide rubber stair treads with raised profile surface pattern; #96.
 - b. Thickness: Not less than 3/16" nominal and ¼ nosing.
 - c. Nose Design: Class 1, round nose.
- D. Resilient Risers: Provide single-piece riser for height and width of stair risers or equal-sized units if rise width exceeds available manufactured lengths.
 - 1. Provide rubber risers for stairs where indicated.
 - 2. Size: 7" cove base, 1/8" ga.
- E. Resilient Landing Tiles: Provide tiles with raised profile surface pattern (#996) where indicated, and as follows:
 - 1. Size: 19-11/16" x 19-11/16"
 - 2. Thickness: 5/32"
 - 3. Backing: Smooth factory sanded backing.
- F. Adhesives (Cements): Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.
- G. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.
- H. Leveling and Patching Compounds: Latex types as recommended by flooring manufacturer.

PART 3 - EXECUTION:

3.01 INSPECTION:

- A. Require Installer to inspect subfloor surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, ridges, coatings preventing adhesive bond, and other defects impairing performance or appearance.
- B. Do not allow resilient flooring work to proceed until subfloor surfaces are satisfactory.

3.02 PREPARATION:

- A. Prepare subfloor surfaces as follows:

1. Use leveling and patching compounds as recommended by resilient flooring manufacturer for filling small cracks, holes and depressions in subfloors.
 2. Remove coatings from subfloor surfaces that would prevent adhesive bond, including curing compounds incompatible with resilient flooring adhesives, paint, oils, waxes and sealers. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents.
- B. Perform subfloor moisture testing in accordance with:
1. ASTM F 2170: Standard Test Method for Determining Relative Humidity in Concrete Slabs Using in situ Probes. Relative humidity shall not exceed 87%.
 2. ASTM F 1869: Standard Test Method for Measuring Moisture Vapor Emission Rate (MVER) of Concrete Subfloor Using Anhydrous Calcium Chloride (CaCl may not exceed 8lbs).
 3. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.
- C. Perform pH tests (pH may not exceed 10lbs and read no lower than 7lbs) on concrete floors regardless of their age or grade level. All test results shall be documented and retained.
- D. Broom clean or vacuum surfaces to be covered, and inspect subfloor.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.03 INSTALLATION:

A. General:

1. Install resilient flooring using method indicated in strict compliance with manufacturer's printed instructions. Extend resilient flooring into toe spaces, door reveals and into closets and similar openings.
2. Scribe, cut and fit resilient flooring to permanent fixtures, built-in furniture and cabinets, pipes, outlets and permanent columns, walls and partitions.
3. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.
4. Tightly cement resilient flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.
5. Install resilient flooring on covers for telephone and electrical ducts, and similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with

pieces of flooring installed on these covers. Tightly cement edges to perimeter of floor around covers and to covers.

B. Installation of Tile Floors:

1. Lay tile from center marks established with principal walls discounting minor offsets, so that tile at opposite edges of room area are of equal width. Adjust as necessary to avoid use of cut widths less than $\frac{1}{2}$ tile at room perimeters. Lay tile square to room axis, unless otherwise shown.
2. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged if so numbered. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.
3. Lay tile in "checkerboard" fashion with grain reversed in adjacent tiles.
4. Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring mfr's directions.

C. Installation of Accessories:

1. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practical, with preformed corner units. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
2. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring, which would otherwise be exposed.

3.04 CLEANING AND PROTECTION:

A. Perform following operations immediately upon completion of resilient flooring:

1. Sweep or vacuum floor thoroughly.
2. Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed to allow resilient flooring to become well-sealed in adhesive.
3. Damp-mop floor being careful to remove black marks and excessive soil.
4. Remove any excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturer.

B. Protect flooring against damage during construction period to comply with resilient flooring manufacturer's direction.

1. Apply protective floor polish to resilient flooring surfaces free from soil, excess adhesive or surface blemishes. Use commercially available metal cross-linked acrylic product acceptable to resilient flooring manufacturer.
2. Cover resilient flooring with undyed, untreated building paper until inspection for substantial completion.

- C. Clean resilient flooring not more than 4 days prior to date scheduled for inspections intended to establish date of Substantial Completion in each area of project. Clean resilient flooring by method recommended by resilient flooring manufacturer.

3.05 EXTRA STOCK:

- A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
 - 1. Tile Flooring: Furnish not less than one box for each 50 boxes, or fraction thereof, for each type, color, pattern and size installed.
 - 2. Base: Furnish not less than 10% maintenance stock for each type, color and size installed.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SCOPE OF WORK:

- A. Furnish all materials, labor, tools, equipment, services and other incidentals required to perform work as listed.

1.03 SUMMARY:

- A. This Section includes the following:
 - 1. Carpet tile, fully adhered.
 - 2. Accessories.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 09 65 00 – Resilient Flooring.
 - 3. Section 09 65 36 – Static Control Resilient Flooring.
 - 4. Section 09 69 00 – Access Flooring.

1.04 REFERENCES:

- A. Americans with Disabilities Act (ADA): Section 4.5.3 Accessibility Guidelines for Buildings & Facilities.
- B. American Association of Textile Chemists and Colors (AATC).
- C. Aachener Test: Dimensional Stability (DIN Standard 54318).
- D. American Society for Testing and Materials (ASTM)
- E. Consumer Product Safety Commission (CPSC)
- F. Carpet & Rug Institute Standards
- G. NSF International (NSF 140 Sustainable Carpet Standard)
- H. California Department of General Services (California Gold Sustainable Carpet Standard)
- I. Scientific Certification Systems (SCS)

- J. US Green Building Council – LEED Rating System
- K. International Organization for Standardization (ISO)
- L. American National Standards Institute (ANSI)

1.05 SUBMITTALS:

- A. Shop Drawings and Product Data: Submit for all products proposed for use, describing physical characteristics, sizes, patterns, colors available, and method of installation.
- B. Test Reports: Provide certified test reports, prepared by an independent testing laboratory, showing conformance to specified performance standards. Test results shall represent average results for production goods, and shall not be over two years old.
- C. Samples: Submit four tiles in each color selected for project, demonstrating color, backing and pattern.
- D. Maintenance Data: Submit manufacturer's recommended cleaning and maintenance data as specified in Section 01700. Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.06 QUALITY ASSURANCE:

- A. Qualifications:
 - 1. Manufacturer: Company specializing in carpet tile manufacturing with a minimum of ten continuous years of documented experience. Carpet manufacturing processes must be certified by a recognized ISO registrar to the current requirements of ISO 14001 for environmental management systems as established by the International Organization for Standardization (1987, revised 1994).
 - 2. Installer: Company, with a minimum of five years documented experience in the installation of carpet tiles, certified or accredited by manufacturer.
 - 3. Submit a list of at least five (5) installations that have been in use for a minimum of three (3) years using carpet tile as described in this document. Include contact name and phone numbers.
 - 4. Installer shall have documented experience with a formal lift system when applicable to the job.
 - 5. Pre-Installation Meeting: After approval of submittals but prior to beginning installation of work of this Section, conduct a meeting at the site attended by architect, contractor, carpet installer and carpet material manufacturer to describe in detail the installation process and to establish agreement, coordination and responsibilities. Prepare a detailed report of this meeting and furnish copies to the architect and all attendees.

1.07 TEST REQUIREMENTS:

- A. Carpet furnished under this Section shall comply with the following test requirements.

1. Carpet and Rug Institute (CRI)-TM-101 “Severe” Appearance Retention Rating in conformance with ASTM D-5252 Hexapod test method using number of cycles for short and long-term test cycles as specified.
 - a. The exposure conditioned carpet shall be assessed according to CRI TM 101- Assessment of Carpet Surface Appearance Change using CRI Carpet Appearance Retention Grading Scales. To meet the “Severe” Appearance Retention Rating carpet shall have a short term rating >4.0 and a long-term rating >3.5 in conformance with the CRI Carpet Appearance Retention Grading Scales.
2. Flame / Smoke Resistant Standards - Provide carpet complying with ratings as indicated for the following:
 - a. Flooring Radiant Panel Test - ASTM E-648-78 and/or NFPA 253 Carpeting shall have a minimum critical radiant flux of forty-five hundredths (0.45) watts per square centimeter (cm²).
 - b. Methenamine Tablet Test - DOC-FF-1-70 and/or ASTM D 2859-76. Carpet shall meet the "Standards for the Surface Flammability of Carpets"
 - c. Smoke Density Test - NFPA 258 and/or ASTM E 662-83 Carpet shall have a specific optical density (DM) of four hundred fifty (450) or less (flaming).
3. Colorfastness to Light - AATCC 16, Option E: Minimum rating of 4 on grey scale after 80 hours exposure.
4. Colorfastness to Crocking AATCC 165: Minimum rating of 4 wet and dry.
5. AACHEN Test: 36” x 36” Tiles - Dimensional stability 0.2 percent shrinkage or growth.
6. Static Resistance: carpet construction to provide a minimum of 3.0 KV resistance for 20% R. H. at 70 degrees, AATCC 134.
7. Stain Resistance: AATCC TM-175 Stain Resistance: Pile Floorcoverings – must meet a grade of 6.0 or better after removal of any topical treatment.
8. ASTM F1869-98 Calcium Chloride Test: carpet must be able to support water vapor transmission from substrate of up to 8 lbs per 1000 sq. ft. Where carpet alone fails to meet this requirement, installer must include utilization of a manufacturer approved sealer treatment system that enables compliance.
9. Environmental Sustainable Carpet Assessment Standard NSF 140:2007 Manufacturer and specified product must be tested and certified at a Minimum Gold Level
10. Moisture Barrier Properties: in accordance with the Moisture Penetration by Dynamic Impact Test – No moisture penetration detected after 10,000 impacts @ 10 psi.
11. Owner mandates use of PVC Free (polyvinyl chloride) carpets.
12. Owner prefers the utilization of adhesive free backing systems to optimize indoor air quality and reduce environmental impact.
13. Carpet Fiber must be 100% Type 6.6 Nylon.

14. Carpet and installation procedures shall meet or exceed requirements as set forth by the provisions of the American Disability Act.
15. Carpet and adhesives must meet or exceed qualifications for environmental standards of the Carpet and Rug Institute's Green Label Plus Program and South Coast Requirements

1.08 DELIVERY AND STORAGE:

- A. Deliver all materials to the installation site in the manufacturer's original packaging. Packaging shall contain manufacturer's name, product color and pattern name, identification number, and other related information.
- B. Carpet tiles shall be stored between 40°F and 100°F and shall be conditioned to between 60°F and 90°F for 48 hours prior to installation.

1.09 PROJECT SITE CONDITIONS:

- A. All prospective bidders are required to visit the job site to familiarize themselves with the work on hand, in preparation of their bid.
 1. Substrate: Flooring Contractor must examine the substrate, and the conditions under which the carpeting is to be installed, and notify the contractor, in writing, of the conditions detrimental to the proper and timely completion of the work.
 2. Floor temperature shall be a minimum of 60°F for proper adhesive performance.
 3. Floor pH shall not exceed 10.0 (acid etch using a 50/50 vinegar and water or a 1/20 muriatic acid and water solution if greater than 10.0).
 4. Water vapor transmission of sub-floor shall not exceed 8 lbs. per 1,000 square feet per 24-hour period as determined by the #625 Calcium Chloride Test.
 5. Permanent building lights or lighting of equal brilliance available during installation.

1.10 WARRANTY:

- A. Provide certified copies of the following manufacturer's product warranties.
 1. Lifetime Warranty against excessive surface wear
 2. Lifetime Latent Defects Warranty
 3. Lifetime Delamination Warranty
 4. Lifetime Edge Ravel Warranty
 5. Lifetime Floor Compatibility Warranty
 6. Lifetime Antistatic Guarantee
 7. Lifetime Antimicrobial Properties
- B. Warranty shall be sole source responsibility of the manufacturer. Second source warranties or warranties that involve parties other than the manufacturer are unacceptable.

1. Warranties are official documents and shall not be issued on job sheets.

1.11 EXTRA MATERIALS:

- A. Provide up to 5%, but not less than one carton or bundle, of each color and pattern, minimum of one (1) carton under provisions of Section 01 7700.

1.12 DELIVER SPECIFIED ATTIC STOCK REQUIREMENTS TO OWNER'S DESIGNATED STORAGE SPACE, PROPERLY PACKAGED AND IDENTIFIED.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturers:

1. Shaw Contract.

- B. Section 01 6000 - Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 MATERIALS:

- A. Carpet Tile: Diffuse, 59575; Flutter, 75761; quarter turn.

2.03 ENVIRONMENTAL IMPACT CHARACTERISTICS:

- A. Carpet shall conform to the following environmental characteristics:

1. Carpet manufacturing processes is certified by a recognized ISO registrar to the current requirements of ISO 14001 for environmental management systems
2. Manufacturer has an established reclamation process for recycling used carpet
3. Carpet Backing System contains no polyvinyl chloride (PVC) content
4. Carpet Backing System must contain a minimum of 25% recycled content
5. Carpet shall have a "Severe" Appearance Retention Rating (CRI TM-101) to insure extended performance life
6. Low Emitting Materials – Adhesives and Carpets must meet or exceed the CRI Green Label Plus Indoor Air Quality Testing Requirements
7. Construction Waste Management – At least 50% of the used carpet shall be able to be recycled, reused or salvaged by weight of construction
8. Carpet Gold or Platinum Certified with NSF 140: 2005 Sustainable Carpet Assessment Standard for certification as SCS Sustainable Choice™ Gold Environmentally Preferable Product
9. All products must be third party certified as Carbon Neutral. No purchase of credits shall be allowed to offset emissions.

2.04 ACCESSORIES:

- A. Leveling Compound: Latex type as recommended by carpet tile manufacturer, compatible with carpet adhesive and curing/sealing compound used on concrete.
- B. Releasable Pressure-Sensitive Type Adhesive: Low VOC (no solvents) type releasable carpet tile adhesive as recommended by carpet manufacturer; comply with CRI Green Label Certification Program; permit removal of carpet tile at any time without damage or adhesion to carpet. Adhesive shall be as approved by the manufacturer.
- C. Edge strips: Flooring material.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Examine substrates for conditions under which carpeting is to be installed.
- B. Verify that floor surfaces are smooth and flat within tolerances specified and are ready to receive work.
- C. Beginning of installation means installer accepts existing substrate conditions.

3.02 PREPARATION:

- A. Perform moisture content testing as required by manufacturer's instructions to ensure pH readings of no more than ten (10). Moisture vapor transmission of 3.0 lbs. per 1,000 square feet per 24 hours is acceptable. If values exceed this level, follow manufacturer's recommendations for moisture transmission mitigation. Do not proceed until unsatisfactory conditions have been corrected.
- B. Fill, level and make smooth cracks 1/16 inch or more, holes, unevenness and roughness with compatible latex floor patching compound. Feather floor filling or leveling compound a minimum of four (4) ft. Sweep floor of loose granular debris prior to filling. After filling, allow filler to dry. Damp mop floor with warm water and allow to dry. Vacuum after mopping to ensure that loose granular debris is removed and to provide a proper substrate to install carpet tiles. Prohibit traffic until filler is cured.
- C. Vacuum floors again immediately before installation of carpeting.
- D. Confirm compatibility of adhesive with curing compounds on concrete floors.
- E. Preheat areas to receive carpet to a minimum temperature of 68° F. for 72 hours prior to installation, with a relative humidity of not more than 65%. Maintain minimum temperature of 60° F. thereafter. Carpet and adhesive must be stored at a minimum temperature of 68° F. for 72 hours prior to installation.

3.03 INSTALLATION:

- A. Install carpet in accordance with the Technical Bulletins provided by the manufacturer. These technical bulletins will offer the proper instructions of how to install the carpet including (1) Conducting Site Testing and conditioning (2) Floor Preparation (3) Installation of the carpet (including seaming, carpet layout and cutting, power stretching, approved adhesives systems and

seam sealers, etc.) As a supplement, the CRI 104, Section 8, will supply additional installation support guidance for your installation.

- B. Install carpet under open-bottom obstructions and under removable flanges and furnishings, and into alcoves and closets in each space.
- C. Provide cutouts where required. Conceal cut edges with protective edge guards or flanges.
- D. Run carpet under open-bottom items and install tight against walls, columns, and cabinets so that the entire floor area is covered with carpet. Cover over floor-type door closers.
- E. Install edging guard at openings and doors wherever carpet terminated, unless indicated otherwise.
- F. Perform cutting in accordance with manufacturer's recommendations using tools designed for carpet being installed. Retain or dispose of scraps in accordance with manufacturer's environmental program.
- G. Butt edges with proper pressure to attain the tightest joint possible without distortion.
- H. Install carpet tile with pile-lay in same direction, except when a quarter-turned method is indicated on Drawings. For quarter turned installations, install carpet so that arrows point in same direction on every other tile and on adjacent diagonal tiles. Consistently turn arrows on alternating tiles 90° in either direction.
- I. Do not bridge building expansion joints with continuous carpeting.
- J. Divide room into four (4) quadrants and snap a chalk line. Ensure that quadrants meet at right angles (offset center line, if necessary, to ensure that perimeter tiles will be cut no less than half size).
- K. Apply environmentally approved adhesive in accordance with manufacturer's instructions in area to be carpeted first.
- L. Begin installation of carpet by laying an anchor row of tiles on one side of center chalk line. Ensure straight lines and square corners. Repeat anchor rows in each quadrant, extending out from the center. Fill in each quadrant with tiles, using stair-step technique.
- M. Tip individual tiles into place to avoid catching pile in joint. Frequently check tile joints for proper alignment and firm abutment.
- N. Tiles are nominally 24 x 24 inches square. There may be a slight gain in measurement due to joints. See manufacturer's instructions for installing 24 x 24 inch tiles.
- O. Cut tiles from back. Secure cut or partial tiles with adhesive.
- P. Install tile over electrical boxes and mark location with a piece of tape. Lift tiles for cutouts after electrical floor outlets have been wired.
- Q. Center trench headers directly under a full tile row.
- R. Use a fixed reducer strip to secure tile area in open perimeter designs.

3.04 FIELD QUALITY CONTROL:

- A. Inspect completed carpet installation on each floor.
- B. Verify that installation is complete, work is properly done and acceptable.
- C. Remove and replace, at no additional cost to Owner, any work found not to be acceptable.

3.05 CLEANING:

- A. On completion of installation in each area, remove dirt and carpet scraps from surface of carpet. Remove soiling, spots, or excess adhesive on carpet with cleaning materials recommended by carpet manufacturer.
- B. Remove debris; sort pieces from carpet scraps to be redirected and recycled.
- C. At completion of work, vacuum carpet using commercial vacuuming equipment as recommended by carpet manufacturer. Remove spots and replace carpet where spots cannot be removed. Remove rejected carpeting and replace with new carpeting. Remove any protruding yarns with shears or sharp scissors.

3.06 PROTECTION:

- A. Do not permit traffic over unprotected floor surface.
- B. Protect carpet against damage during construction period. Cover with 6 mm thick polyethylene covering with taped joints during construction period whenever protection is required, so that carpet will be without any indication of deterioration, wear or damage at time of Substantial Completion.
- C. Damaged carpet will be rejected and recycled. As carpet is installed, remove trimmings, excess pieces of carpet and installation materials.
- D. Maintain protection of carpeting on each floor or area until work is accepted.

END SECTION

SECTION 09 77 00

SPECIAL WALL SURFACING

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SUMMARY:

- A. Section Includes: Special wall surfaces, including fiberglass reinforced plastic panels.
- B. Related Sections: Section(s) related to this section include:
 - 1. Section 07 92 00 – Joint Sealants.
 - 2. Section 09 20 00 – Gypsum Board.
 - 3. Section 09 65 00 – Resilient Flooring.
 - 4. Division 26 – Electrical.

1.03 REFERENCES:

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. ASTM International:
 - 1. ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
 - 2. ASTM D5420 Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
 - 3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 SYSTEM DESCRIPTION:

- A. Performance Requirements: Provide fiberglass reinforced plastic (FRP) panels, which have been manufactured and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.05 SUBMITTALS:

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 Submittal Procedures Section.
- B. Product Data: Submit product data, including manufacturer's SPEC-DATA® product sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures. Indicate location and dimension of joints and fastener attachment.
- D. Samples: Submit selection and verification samples for finishes, colors and textures. Submit 2 samples of each type of panel, trim and fastener.
- E. Quality Assurance Submittals: Submit the following:
 - 1. Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.
 - 2. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics, criteria and physical requirements.
 - 3. Manufacturer's Instructions: Manufacturer's installation instructions. Submit manufacturer's Installation Guide #6211.
- F. Closeout Submittals: Submit the following:
 - 1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 01 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.
 - 2. Warranty: Warranty documents specified herein.

1.06 QUALITY ASSURANCE:

- A. Qualifications:
 - 1. Installer Qualifications: Installer should be experienced in performing work of this section and should have specialized in installation of work similar to that required for this project.
 - a. Certificate: When requested, submit certificate indicating qualifications.
 - 2. Manufacturer Qualifications: Manufacturer should be capable of providing field service representation during construction and should be capable of approving application method.
- B. Regulatory Requirements:
 - 1. International Building Code.
- C. Preinstallation Meetings: Conduct preinstallation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 01 Project Management and Coordination (Project Meetings) Section.

1.07 DELIVERY, STORAGE & HANDLING:

- A. General: Comply with Division 01 Product Requirements Sections.
- B. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Package sheets on skids or pallets for shipment to project site.
- D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer. Store panels indoors in a dry place at the project site.
- E. Handling: Remove foreign matter from face of panel by using a soft bristle brush, avoiding abrasive action.

1.08 PROJECT CONDITIONS:

- A. Environmental Requirements:
 - 1. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or epoxy flooring work has dissipated.
 - 2. During installation, and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
 - 3. Provide ventilation to disperse fumes during application of adhesive as recommended by adhesive manufacturer.
- B. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.09 WARRANTY:

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Warranty Period: Five years commencing on Date of Substantial Completion.

1.10 MAINTENANCE:

- A. Extra Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 01 Closeout Submittals (Maintenance Materials) Section.
 - 1. Quantity: Furnish quantity of panels and accessory units equal to 5 % of amount installed.
 - 2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra materials.

PART 2 - PRODUCTS:

2.01 FIBERGLASS REINFORCED PLASTIC (FRP) PANELS:

A. Acceptable Manufacturers (Basis of Design):

1. Crane Composites, Inc.
2. Other acceptable manufacturers:
 - a. Marlite, Inc.
 - b. Partafab Corporation.
3. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

B. Kemply Panels:

1. FRP Face: Fire-X Glasbord FX.
2. Color: Ivory, 84.
3. Texture: Pebble embossed.
4. Size: 4 feet × 8 feet.
5. Moldings: Provide harmonizing PVC (polyvinyl chloride) moldings. Color to be selected by Owner/Architect from manufacturer's standard colors.

C. Surfaseal Surface Protection: Provide manufacturer's proprietary Surfaseal surface protection for fiberglass reinforced plastic (FRP) panels.

D. Division Bars, Corner Trim: Panel manufacturer's standard length extruded vinyl pieces; longest length possible to eliminate end joints.

E. Fasteners: Noncorrosive drive rivets.

2.02 ACCESSORIES:

A. Adhesive: Provide panel adhesive as recommended by panel manufacturer.

2.03 RELATED MATERIALS:

A. Related Materials: Refer to other sections listed in Related Sections paragraph herein for related materials.

2.04 SOURCE QUALITY:

A. Source Quality: Obtain fiberglass reinforced plastic (FRP) panels from a single manufacturer. Provide panels and molding only from manufacturer specified to ensure warranty and color harmonization of accessories.

PART 3 - EXECUTION:

3.01 MANUFACTURER'S INSTRUCTIONS:

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.02 EXAMINATION:

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
 - 1. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails are countersunk and joints and cracks are filled flush and smooth with the adjoining surface.
 - 2. Do not begin installation until backup surfaces are in satisfactory condition.

3.03 INSTALLATION:

- A. Fiberglass Reinforced Panel (FRP) Installation:
 - 1. Cut and drill panels with carbide tipped saw blades or drill bits, or cut with snips.
 - 2. Install panels with manufacturer's recommended gap for panel field and corner joints.
 - 3. Predrill fastener holes in panels with 1/8 inch (3.2 mm) oversize.
 - 4. For trowel type and application of adhesive, follow adhesive manufacturer's recommendations.
 - 5. Use products acceptable to panel manufacturer and install FRP system in accordance with panel manufacturer's printed instructions. Comply with panel manufacturer's Installation Guide #6211.
- B. Site Tolerances: + 1/8".
- C. Finish Color/Patterns: Finish shall be uniform with color selected by the Owner/Architect.
- D. Related Products Installation: Refer to other sections listed in Related Sections paragraph herein for related materials installation.

3.04 CLEANING:

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace products that have been installed and are damaged. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.
 - 1. Remove any adhesive or excessive sealant from panel face using solvent or cleaner recommended by panel manufacturer.

3.05 PROTECTION:

- A. Protection: Protect installed product and finish surfaces from damage during construction.

END OF SECTION

SECTION 09 91 00

PAINTS AND COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Extent of painting work is indicated on drawings and schedules, and as herein specified.
- B. Work includes painting and finishing of interior and exterior exposed items and surfaces throughout project, except as otherwise indicated.
 - 1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
- C. The work includes field painting of all new surfaces constructed on the project including, but not limited to, exposed bare and covered pipes and ducts, and of hangers, exposed steel and iron work and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.
 - 1. New concrete surfaces do not require painting unless otherwise noted on the drawings or painting schedule.
 - 2. Existing surfaces do not require painting unless otherwise noted on the drawings or painting schedule.
- D. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats
- E. Surfaces to be painted: Paint exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Engineer will select these from standard colors or finishes available.
- F. Following categories of work are not included as part of field-applied finish work, or are included in other sections of these specifications.
 - 1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, miscellaneous metal, hollow metal work and similar items.
 - 2. Pre-finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) acoustical materials, architectural woodwork and casework, finished mechanical and electrical equipment including light fixtures, switch-gear and distribution cabinets.
 - 3. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces and duct shafts.

- a. Ductile iron pipe scheduled for insulation shall be painted prior to insulating.
4. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
5. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identifications, performance rating, name or nomenclature plates

1.02 RELATED REQUIREMENTS

A. Related Specifications

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 04 20 00 – Unit Masonry Assemblies
3. Division 05 – Metal Work
4. Section 06 10 00 – Rough Carpentry
5. Section 06 40 23 – Interior Architectural Woodwork.
6. Section 07 92 00 – Joint Sealants.
7. Section 08 11 13 – Hollow Metal Doors & Frames.
8. Section 08 14 16 – Flush Wood Doors.
9. Section 08 31 13 – Access Doors & Panels.
10. Section 09 20 00 – Gypsum Board.
11. Section 13 34 19 – Metal Building Systems.
12. Division 21 – Fire Suppression.
13. Division 22 – Plumbing.
14. Division 23 – Mechanical.
15. Division 26 – Electrical.
16. Division 32 – Exterior Improvements
17. Section 40 05 97 – Identification of Process Piping and Equipment

1.03 REFERENCES

A. Society for Protective Coatings (SSPC)

1. SSPC-SP 2: Hand Tool Cleaning
2. SSPC-SP 3: Power Tool Cleaning
3. SSPC-SP 5: White Metal Blast Cleaning

4. SSPC-SP 6: Commercial Blast Cleaning
 5. SSPC-SP 10: Near-White Blast Cleaning
 - B. American Society for Testing and Materials (ASTM)
 1. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications
- 1.04 SUBMITTALS
- A. Submit under provisions of Section 01 33 00
 - B. Product Data: For each system indicated including:
 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. Preparation instructions and recommendations
 3. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
 - C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns
- 1.05 QUALITY ASSURANCE
- A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.
 - B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.
 - C. Installer Qualifications: Minimum 5-years experience in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- 1.06 DELIVERY, STORAGE AND HANDLING:
- A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
 1. Name or title of material.
 2. Federal Specification number, if applicable.
 3. Manufacturer's stock number and date of manufacture.
 4. Manufacturer's name.

5. Contents by volume, for major pigment and vehicle constituents.
 6. Thinning instructions.
 7. Application instructions.
 8. Color name and number
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue. Protect from freezing where necessary.
- C. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.
- 1.07 PROJECT CONDITIONS
- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Apply water base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50° F (10° C) and 90° F (32° C), unless otherwise permitted by paint manufacturers printed instructions.
- C. Apply solvent thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45° F (7° C) and 95° F (35° C), unless otherwise permitted by paint manufacturer's written instructions.
- D. Do not apply paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.
- E. COLOR SELECTIONS:
1. All color selections shall be made by the Owner or Engineer.
 2. Colors for water and waste water piping and appurtenances shall be in accordance with "10 States Standards" unless otherwise scheduled by the Engineer.
 - a. Small diameter non-metallic lines should not be painted but should be color-coded with the colors specified using labels according to the "Signs and Labels" section.
 3. Where more than one coat of paint is required, paint for each undercoat shall be job tinted off shade, sufficient to show complete coverage for each coat.
- 1.08 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and, in the quantities, described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
- B. Quantity: Furnish Owner with an additional three percent (3%), but not less than 1 gal (3.8 l) or 1 case, as appropriate, of each material and color applied

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products from one of the following:
 - 1. Tnemec Company, Inc. is the basis of design.
 - 2. Acceptable manufacturers if they meet the basis of design
 - a. Sherwin-Williams Company
 - b. Carboline
 - c. Minwax Company

2.02 MATERIALS

- A. Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.
 - 1. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.
- B. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.
 - 1. Lead content in pigment, if any, is limited to contain not more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint by weight.
 - 2. This limitation is extended to interior surfaces and those exterior surfaces, such as windows and doors that are readily accessible to children under 7 years of age

2.03 TESTING EQUIPMENT

- A. Contractor will furnish the Engineer with DeFesco, BYK-Gardner or equal PosiTector 6000, dry film thickness gauge measurements during the project.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.
- B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
- C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film

3.02 SURFACE PREPARATION

- A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified for each particular substrate condition.
 - 1. Remove hardware, hardware accessories, machined surfaces, plates and similar items in place and not to be finish-painted or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.
 - 2. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Engineer in writing of any anticipated problems in using the specified coating systems with substrates primed by others.
 - 3. All voids, open or hollow places shall be repaired with a material suitable to the surface to be repaired
 - 4. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.
- B. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block, cement plaster and cement-asbestos board to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, mildew, loose paint, wax, and any other contamination, and by roughing as required to remove glaze. Remove any form release agents or curing compounds following SSPC SP-1 guidelines.
 - 1. Cast-in-place concrete work shall be rubbed and finished in accordance with provisions of Section 03 30 00, Cast-In-Place Concrete prior to painting.
 - 2. Prepare surfaces as noted in Part 3 of this specification
 - 3. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- C. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill

holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

1. Prime, stain or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides and backsides of such wood, including cabinets, counters, cases, paneling.

D. Ferrous Metals:

1. Miscellaneous iron and steel work and structural steel work before leaving the shop of the fabricator and before being exposed to weather, shall be thoroughly cleaned of all foreign matter, loose black scale and rust to a SSPC-SP 2 or SP3 standard and shall receive a pretreatment shop prime.
2. Ferrous surfaces, which are not galvanized or shop-coated, shall be cleaned of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
 - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, solvent clean, and touch up with same primer as the shop coat.
 - b. Blast-clean steel surfaces as recommended by coating manufacturer and according to the following:
 - 1) Submerged cast iron and ductile iron piping: SSPC 5 "White Metal Blast" or SSPC-SP10 "Near White Blast" as noted in Part 3 of this specification.
 - 2) Exposed, Non-submerged cast iron and ductile iron piping: SSPC-SP6 "Commercial Blast Cleaning" unless noted otherwise for the painting system in Part 3 of this specification.

E. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent. Test galvanized metal surface for passivator treatment. If passivator treatment is present it must be removed prior to the application of coatings.

F. Aluminum Storefront: Solvent clean, per SSPC SP-1, substrate to remove any contamination that may be present. Abrade substrate to remove gloss and roughen the surface to obtain a minimum surface profile of 1.0 mills. Prior to coating, solvent wipe substrate to remove dust and residual contamination.

3.03 APPLICATION

A. General

1. Painting shall be done in a first-class, workmanlike manner, and no paint shall be applied upon damp or frosty surfaces or in wet, foggy or freezing weather.
2. Paint shall be evenly spread and well brushed out, so there shall be no drops, runs or sagging of the coating. Where runs and drops do occur, they shall be removed and the surface recoated to the satisfaction of the Engineer.
3. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

4. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, weld, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
5. Paint surfaces behind moveable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment
6. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
7. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.
9. Sand lightly between each succeeding enamel and varnish coat
10. Drop cloths shall be used to protect other surfaces of the structure or equipment in place, and upon completion of work all paint spots shall be removed from surfaces as directed by the Engineer, and any defaced surfaces shall be refinished as directed by the Engineer.

B. Scheduling Painting

1. Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Minimum Coating Thickness:

1. Apply materials at no less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated in the schedule or if not indicated, as recommended by coating manufacturer.

D. Prime Coats

1. Apply prime coat of material which is required to be painted or finished and which has not been prime coated by others.
2. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

E. Pigmented (Opaque) Finishes

1. Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

F. Completed Work

1. Match approved samples for color, texture and coverage.
2. Remove, refinish or repaint work not in compliance with specified requirements.

3.04 PAINTING SYSTEMS

A. Structural Steel and Miscellaneous Iron and Steel

1. Exterior Metals, Non-Immersion
 - a. Surface Preparation – SSPC-SP6 “Commercial Blast Cleaning”
 - b. Primer – Tnemec Series 1 or equal. DFT 2.5.0 to 3.5 Mils.
 - c. First Coat – Tnemec Series 135 or equal. DFT 3.0 to 4.0 mils.
 - d. Second Coat – Tnemec Series 1095 or equal. DFT 2.0 to 2.5 mils.
 - e. Total DFT 7.5 to 10.0 mils.
2. Interior, Non-Immersion
 - a. Surface Preparation – SSPC-SP6 “Commercial Blast Cleaning”
 - b. Primer – Tnemec Series 66 or equal. DFT 3.0 to 5.0 Mils.
 - c. First Coat – Tnemec Series 1029 or equal. DFT 2.0 to 3.0 mils.
 - d. Total DFT 7.0 to 11.0 Mils.
3. Immersion, Potable Water
 - a. Surface Preparation – SSPC-SP10 “Near White Metal Blast Cleaning”
 - b. Primer – Tnemec Series L140 or equal. DFT 4.0 to 8.0 Mils.
 - c. First Coat – Tnemec Series L140 or equal. DFT 4.0 to 8.0 mils.
 - d. Total DFT 8.0 to 16.0 Mils
4. Immersion, Non-Potable Water
 - a. Surface Preparation – SSPC-SP 10 “Near White Metal Blast Cleaning”
 - b. Primer – Tnemec Series N69 or equal. DFT 4.0 to 8.0 Mils.
 - c. First Coat – Tnemec Series N69 or equal. DFT 4.0 to 8.0 mils.
 - d. Total DFT 8.0 to 16.0 Mils

B. Ductile and Cast Iron Pipe

1. Exterior, Non-Immersion

- a. Surface Preparation – Surface shall be prepared by applying NAPF 500-03-03 “Power Tool Cleaning.” The substrate should be clean, dry and free of all contaminants prior to painting.
- b. Primer – Tnemec Series 135 or equal. DFT 3.0 to 4.0 Mils.
- c. First Coat – Tnemec Series 1095 or equal. DFT 2.0 to 3.0 mils.
- d. Total DFT 5.0 to 7.0 Mils

2. Interior, Non-Immersion:

- a. Surface Preparation – Surface shall be prepared by applying NAPF 500-03-03 “Power Tool Cleaning.” The substrate should be clean, dry and free of all contaminants prior to painting.
- b. Primer – Tnemec Series N69 or equal. DFT 4.0 to 8.0 Mils.
- c. First Coat – Tnemec Series N69 or equal. DFT 4.0 to 8.0 mils.
- d. Total DFT 8.0 to 16.0 Mils

3. Immersion, Potable Water:

- a. Surface Preparation – Surface shall be prepared by applying NAPF 500-03-03 “Power Tool Cleaning.” The substrate should be clean, dry and free of all contaminants prior to painting.
- b. Primer – Tnemec Series L140 or equal. DFT 4.0 to 8.0 Mils.
- c. First Coat – Tnemec Series L140 or equal. DFT 4.0 to 8.0 mils.
- d. Total DFT 8.0 to 16.0 Mils

4. Immersion, Non-potable Water:

- a. Surface Preparation – Surface shall be prepared by applying NAPF 500-03-03 “Power Tool Cleaning.” The substrate should be clean, dry and free of all contaminants prior to painting.
- b. Primer – Tnemec Series N69 or equal. DFT 4.0 to 8.0 Mils.
- c. First Coat – Tnemec Series N69 or equal. DFT 4.0 to 8.0 mils.
- d. Total DFT 8.0 to 16.0 Mils

C. Galvanized Iron and Aluminum

1. Interior

- a. Surface Preparation – Surface shall be prepared by solvent cleaning the entire substrate to be painted using xylol or xylene. The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. Primer – Tnemec Series 66 or equal. DFT 2.0 to 3.0 Mils.
 - c. First Coat – Tnemec Series 1029 or equal. DFT 2.0 to 3.0 mils.
 - d. Second Coat - Tnemec Series 1029 or equal. DFT 2.0 to 3.0 mils
 - e. Total DFT 6.0 to 9.0 Mils
2. Exterior
- a. Surface Preparation – Surface shall be prepared by abrading the surface to a SSPC-SP3 “Power Tool Cleaning” standard. The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. Primer – Tnemec Series 66 or equal. DFT 2.0 to 3.0 Mils.
 - c. First Coat – Tnemec Series 1095 or equal. DFT 2.0 to 3.0 mils.
 - d. Total DFT 4.0 to 6.0 Mils

D. Concrete

1. Exterior, Below Grade
- a. Surface Preparation – Surface shall be prepared by applying SSPC-SP13 “Surface Preparation of Concrete.” The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. First Coat – Tnemec Series 46H-413 or equal. DFT 14.0 to 20.0 Mils.
 - c. Total DFT 14.0 to 20.0 Mils
2. Exterior, Above Grade (Including Cementitious Siding, Precast, and Cast-In-Place)
- a. Surface Preparation – Surface shall be prepared by applying SSPC-SP13 “Surface Preparation of Concrete.” The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. First Coat – Tnemec Series 1026 or equal. DFT 2.5 0 Mils (6 Mils wet)
 - c. Second Coat – Tnemec Series 1026 or equal. DFT 2.5 0 Mils (6 Mils wet)
 - d. Total DFT 5.0 Mils
3. Immersed Concrete, Potable Water:
- a. Surface Preparation – Surface shall be prepared by applying SSPC-SP13 “Surface Preparation of Concrete.” The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. First Coat – Tnemec Series L140 or equal. DFT 4.0 to 8.0 Mils.

- c. Second Coat – Tnemec Series L140 or equal. DFT 4.0 to 8.0 Mils.
 - d. Total DFT 8.0 to 16.0 Mils
 - 4. Immersed Concrete, Non-potable Water:
 - a. Surface Preparation – Surface shall be prepared by applying SSPC-SP13 “Surface Preparation of Concrete.” The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. First Coat – Tnemec Series 46H-413 or equal. DFT 10.0 to 12.0 Mils.
 - c. Second Coat – Tnemec Series 46H-413 or equal. DFT 10.0 to 12.0 Mils
 - d. Total DFT 20.0 to 24.0 Mils
 - 5. Interior Concrete Walls and Ceilings
 - a. Surface Preparation – The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. First Coat – Tnemec 1029 or equal. DFT 2.0-3.0 Mils
 - c. Second Coat – Tnemec 1029 or equal. DFT 2.0-3.0 Mils
 - d. Total DFT 4.0 to 6.0 Mils
 - 6. Interior Concrete Floors:
 - a. Surface Preparation – Surface shall be prepared be prepared by acid etching the entire surface to be painted to a CSP 1 Standard. The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. First Coat – Tnemec Series 208. DFT 16.0 to 20.0 Mils.
 - c. Second Coat – Tnemec Series 237 pigmented or equal. DFT 8.0 to 10.0 Mils. *For a non-slip surface broadcast 50/70 mesh sand into second field coat unless noted otherwise on the schedule or drawings.*
 - d. Total DFT 24.0 to 30.0 Mils
- E. Concrete Masonry Units
- 1. Interior and Exterior
 - a. Surface Preparation – The substrate should be clean, dry and free of all contaminants prior to painting.
 - b. Block Filler – Tnemec Series 54 or equal. 60-80 ft²/gal.
 - c. First Coat - Tnemec Series 1029 or equal. DFT 2.0 to 3.0 Mils
 - d. Second Coat – Tnemec Series 1029 or equal. DFT 2.0 to 3.0 Mils

F. Architectural PVC, Plastic, and Fiberglass

1. Interior and Exterior

- a. Surface Preparation – The substrate should be clean, dry and free of all contaminants prior to painting.
- b. First Coat - Tnemec Series 1029 or equal. DFT 2.0 to 3.0 mils
- c. Second Coat – Tnemec Series 1029 or equal. DFT 2.0 to 3.0 mils
- d. Total DFT 4.0 to 6.0 Mils

G. Woodwork

1. Exterior

- a. Surface Preparation – The substrate should be clean, dry and free of all contaminants prior to painting.
- b. Primer Coat – Tnemec Series 10-99W or equal. DFT 2.0 to 3.0 Mils
- c. First Coat – Tnemec Series 1028/1029 or equal. DFT 2.0 to 3.0 Mils
- d. Second Coat – Tnemec Series 1028/1029. DFT 2.0 to 3.0 Mils
- e. Total DFT 6.0 to 9.0 Mils
- f. *Allow 4 hours drying time at 75° F between coats.*

2. Interior

- a. Surface Preparation – The substrate should be clean, dry and free of all contaminants prior to painting.
- b. Primer Coat – Tnemec Series 10-99W or equal. DFT 2.0 to 3.0 Mils
- c. First Coat – Tnemec Series 1028/1029 or equal. DFT 2.5 to 3.0 Mils
- d. Second Coat – Tnemec Series 1028/1029 or equal. DFT 2.5 to 3.0 Mils
- e. Total DFT 7.0 to 9.0 Mils
- f. *Allow 4 hours drying time at 75° F between coats.*
- g.

H. Drywall (Walls, Ceiling, Gypsum Board and Similar Items)

1. Interior

- a. Primer – Tnemec Series 51. DFT 1.5 Mils
- b. First Coat – Tnemec Series 1026. DFT 2.0 to 3.0 Mils
- c. Second Coat - Tnemec Series 1026. DFT 2.0 to 3.0 Mils

- d. Total DFT 5.5 to 7.5 Mils

I. Wood Stain and Natural Finish Woodwork

1. Interior

- a. Surface Preparation – The substrate should be clean, dry and free of all contaminants. Wipe wood filler before applying stain.
- b. First Coat – Minwax Pro-Stain Wood Conditioner or equal
- c. Second & Third Coat - Minwax Wood Finish or equal (Alkyd-Based Satin Stain)
- d. Fourth and Fifth Coat - Minwax Fast-Drying Polyurethane (satin)
- e. Sixth Coat - Minwax Fast-Drying Polyurethane (satin)

3.05 PIPING AND EQUIPMENT IDENTIFICATION

- A. Refer to Specification 40 05 97, Identification of Process Piping and Equipment

3.06 CLEAN-UP AND PROTECTION:

- A. Clean-up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.
- B. Upon completion of painting work, clean window glass and other paint-splattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. Protection:
 - 1. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing and repainting, as acceptable to Architect.
 - 2. Provide “Wet Paint” signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
 - 3. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.07 FIELD QUALITY CONTROL:

- A. Engineer/Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
 - 1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove non-complying paint from

Project site, pay for testing, and repaint surfaces previously coated with the non-complying paint. If necessary, Contractor may be required to remove non-complying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

END OF SECTION

SECTION 10 14 67

NON-ILLUMINATED INTERIOR SIGN SYSTEM

PART 1 - GENERAL:

1.01 SUMMARY:

A. Section includes:

1. Interior non-illuminated directional, control, and information surface mounted signage as complete integrated modular system.
2. Dimensional letter signs.

B. Related sections:

1. Section 04 2000: Unit Masonry Assemblies
2. Section 09 2000: Gypsum Board.

1.02 REFERENCES:

A. Standards of the following as referenced:

1. American National Standards Institute (ANSI).

B. Industry standards:

1. Department of Justice, Office of the Attorney General, "Americans with Disabilities Act", Public Law 101-336, (ADA).

C. ANSI A117.1: Providing Accessibility and Usability for Physically Handicap People, 1986 edition.

D. Federal Register Part III, Department of Justice, Office of the Attorney General, 28 CFR Part 36: Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities, Final Rule, July 26, 1991.

E. Federal Register Part II, Architectural and Transportation Barriers Compliance Board, 36 CFR Part 1191: Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Amendment to Final Guidelines, September 6, 1991.

1.03 DEFINITIONS:

A. Terms:

1. Braille: Grade 2 Braille including 189 part-word or whole word contractions in addition to Grade 1 Braille 63 characters. Tactile is required whenever braille is required; see SYSTEM DESCRIPTION Article below.
2. Non-tactile: Letters and numbers on signs with width-to-height ratio between 3:5 and 1:1 and stroke width ratio between 1:5 and 1:10 using upper case "X" to calculate ratios. Use

typestyles with medium weight; upper and lower case lettering is permitted; serif typestyles are permitted. See SYSTEM DESCRIPTION Article below.

3. Symbols: Symbol itself is not required to be tactile but equivalent verbal description is required both in tactile letters and braille.
4. Tactile: 1/32" raised capital letters without serifs at least 5/8" height and not more than 2" height based on upper case "X". Braille is required whenever tactile is required; see SYSTEM DESCRIPTION Article below.

1.04 SYSTEM DESCRIPTION:

- A. Signage under this section is intended to include items for identification, direction, control, and information of building where installed as complete integrated system from a single manufacturer.
- B. ADA design requirements:
 1. Signage requiring tactile graphics:
 - a. Wall mounted signs designating permanent rooms and spaces such as, room numbers and restroom, department, office, and fire exit identifications.
 - b. Individually applied characters are prohibited.
 2. Signage not requiring tactile graphics but require compliance to other ADA requirements: All other signs providing direction to or information about function of space such as, directional signs (signs with arrow), informational signs (operating hours, policies, etc.), regulatory signs (no smoking, do not enter), and ceiling and projected wall mount signs.
 3. Excluded signage:
 - a. Exterior signs.
 - b. Temporary signs include personnel signs and tenant identification; suite numbers are not considered temporary.
- C. ADA performance requirements:
 1. Tactile graphics signs mounting requirements:
 - a. Single doors: Mount 60" to sign centerline above finish floor and on wall adjacent to latch side of door.
 - b. Openings: Mount 60" to sign centerline above finish floor adjacent opening.
 - c. No wall space adjacent latch side of door, opening, or double doors: Mount 60" to sign centerline above finish floor on nearest adjacent wall.

1.05 SUBMITTALS:

- A. Product data:
 1. Manufacturer's signed statement regarding compliance with QUALITY ASSURANCE Article.
 2. Manufacturer's product literature indicating units and designs selected.

3. Evidence of manufacturer's computerized data retrieval program for tracking of Project for sign typography, message strip requirements and other pertinent data from schedule input to final computerized typography on finished product.

B. Shop drawings:

1. Indicate materials, sizes, configurations, and applicable substrate mountings.
2. Typography sample for message strips and headers copy.
3. Artwork for special graphics and headers.
4. Signage schedule complete with location of each sign and required copy; include floor plans.

C. Samples: Full size samples for holder, insert, and copy in colors specified. Provide sample in small size sign. Samples will not be returned for use in Project.

D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

E. Contract close out:

1. Furnish appropriate checklist for aiding in reordering after Date of Substantial Completion. Maintain computer schedule program for five years for ordering new signage required by Owner.
2. Maintenance data and cleaning requirements for exterior surfaces.

1.06 QUALITY ASSURANCE:

A. Qualifications:

1. Manufacturer:
 - a. Work required under this section from manufacturers regularly engaged in work of this magnitude and scope for minimum of five years.
 - b. Maintain computer link between schedule input and computerized typography production.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Acceptance at site: Coordinate delivery of work to Project site under this section for immediate installation.

1.08 SEQUENCING AND SCHEDULING:

- A. Schedule system installation after related finishes have been completed.

PART 2 - PRODUCTS:

2.01 MANUFACTURED UNITS:

- A. Acceptable manufacturers:

1. APCO, IM System; 388 Grant Street SE; Atlanta, Georgia 30312; 404.688.9000.
 2. Creative Impressions; 4708 South Old Peachtree Road; Building 500, Suite B, Norcross, Georgia 30071; 770.582.9936.
 3. ASI Signage Innovations, 8181 Jetstar Drive, Suite 100, Irving, Texas 75063; (214) 352-9140 telephone; (800) ASI-SPEC [274-7732].
- B. Section 01 60 00-Product Requirements: Product selection procedures: Substitutions: Permitted.
- C. Provide the following assemblies; locate where indicated in SCHEDULES Article:
1. Interior sign system: Combination of IM System components, consisting of holder unit mounted to substrate and insert panels secured to holder providing graphic and visual information.
 2. Informer: Combination of holder unit mounted to substrate and insert panel allowing use of panel as emergency plan secured to holder.
- D. Design units with selected components below.
- 2.02 COMPONENTS:
- A. Holder:
1. Material: Integrally colored injection molded high impact UV resistant, colorfast, plastic alloy complete with mounting system; ready for insert installation.
 2. Corners: Square corners.
 3. Edge detail: Bevel edge.
 4. Mounting:
 - a. Surface: Wall or vertical surface.
 - b. Fastening: VTM.
 5. Size: 8" x 8"
 6. Color: Selected by Architect from manufacturer's standard colors.
- B. Insert:
1. Non-tactile signs: Integrally colored injection molded high impact plastic with computer generated photographic silkscreen process surface printing chemically bonded to self-aligning reveal insert material; insert corner same type as holder.
 2. ADA tactile signs: 1/32" thickness computer generated photo-etched rubberized surface material chemically bonded to self-aligning reveal insert material; insert corner same type as holder; silkscreen colors surface applied.
 3. Mounting: PL.
 4. Size: 8" x 8"
 5. Color: Selected by Owner / Architect from manufacturer's standard colors.

C. Graphics:

1. Type sizes: Selected from manufacturer's standard sizes for particular units; meet ADA requirements for letter proportions and sizes where tactile units are used.
2. Type style: HM.
3. Furnish Grade 2 Braille characters for tactile signs; same text as letter designations and symbol translation indicated in DEFINITIONS Article.
4. Type code: Combination.
5. Imprint colors: Selected by Owner / Architect from manufacturer's standard 40 non-glare screening ink colors per unit; color contrast background colors in accord with ADA requirements.

2.03 INFORMER SERIES:

A. Emergency plan:

1. Manufacturer's standard 12" by 12" square holders with vinyl tape mounting.
2. Window insert cover with standard header and blank base with ready for insertion of Owner supplied photocopied floor map; attach to holder with rigid plastic fastener allowing removal with manufacturer's special tool.
3. Lettering:
 - a. EMERGENCY PLAN transfer type self-lettering sheets especially manufactured for this system, complete with burnishing stylus for transferring lettering and symbols to Owner supplied photocopied floor map.
 - b. Description: Red type fire evacuation symbols, black type legends, and blue type routes on sheets.
 - c. Type code: Combination.

2.04 FABRICATION:

A. Shop assembly:

1. Fabricate units to configurations indicated on reviewed shop drawings. Internally reinforce units in accord with reviewed shop drawings.
2. Provide copy on inserts, headers or bases, and covers required on reviewed shop drawings and in accord with ADA requirements.
3. Wrap each individual unit with polyethylene.

PART 3 - EXECUTION:

3.01 EXAMINATION:

A. Verification of conditions:

1. Examine areas to receive signage; notify Architect in writing of unacceptable substrate.
2. Beginning work indicates acceptance of substrate. Subsequent modifications to substrate or signage becomes this section's complete responsibility.

3.02 INSTALLATION:

A. Room signage and emergency plan holders:

1. Install signage holders in locations with mounting types indicated in accord with reviewed shop drawings. Square, plumb, and level units.
2. Install inserts not more than 48 hours prior to Date of Substantial Completion complete with correct copy in place. Conform to ADA requirements for tactile graphics signage.

3.03 CLEANING:

- #### A. Clean exposed surfaces not more than 48 hours prior to Date of Substantial Completion in accord with manufacturers written cleaning instructions.

3.04 SCHEDULES:

A. SIGN SCHEDULE:

1. Provide one sign at each door as indicated in Door Schedule on the drawings.
2. Text and symbols shall be as indicated below:

ROOM SIGNAGE SCHEDULE

Room Number	Text	Symbol
101	Vestibule + Exit (Posted on Interior side)	
102	Office	
105	Break Room	
106	Mechanical	
108	Restroom	
109	Elevator (Top & Bottom Floors)	
110	Restroom	
111	Conference Room	
113	Micro Lab	
114	Electrical	
115	Stairs (Top & Bottom Floors)	
201	Office	
205	Server Room	
207	Janitor	
208	Restroom	
210	Restroom	
212	Lab	
214	Office	

3.05 EMERGENCY PLAN:

- #### A. Provide five (5) emergency plan signs. Locations shall be determined by Owner at a later date.

END OF SECTION

SECTION 10 26 13

CORNER GUARDS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY:

- A. Section Includes:
 - 1. Surface-mounted corner guards.
 - 2. Mounting hardware, accessories, and trim.
- B. Related Sections:
 - 1. Section 06 10 00 – Rough Carpentry.
 - 2. Section 09 20 00 – Gypsum Board.
 - 3. Section 09 91 00 – Paints & Coatings.

1.03 REFERENCES:

- A. ANSI/UL 2079 - Standard for Tests for Fire Resistance of Building Joint System; 1998.
- B. ASTM A 176 - Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip; 1999.
- C. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2000.
- D. ASTM D 256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2002.
- E. ASTM D 543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 1995(2001).
- F. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 1998.
- G. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2001.
- H. CAN/ULC S102.2 - Standard Method of Test for Surface Burning Characteristics of Building Materials.

- I. SAE J-1545 - Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim; 1986.
- 1.04 SUBMITTALS:
- A. Submit under provisions of Section 01 3000.
 - B. Product Data: Manufacturer's complete and current product data for each product required, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Complete installation methods.
 - C. Shop Drawings: Show locations of each item and installation details. Provide elevations of non-standard conditions.
 - D. Selection Samples: Color charts consisting of actual product pieces, demonstrating full range of available colors, for initial color selection.
 - E. Verification Samples: 8 inch (200 mm) long assemblies, including one end cap, in color specified.
- 1.05 QUALITY ASSURANCE:
- A. Provide test reports showing compliance with the performance specified for:
 - 1. Fire-related properties.
 - 2. Accessibility and safety properties.
 - 3. Impact strength.
 - B. Fire Resistance: Where fire ratings are specified for flush mounted corner guards, provide assemblies meeting the requirements of ANSI/UL 2079 to maintain the rating of wall assemblies.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturer: InPro Corporation, which is located at: S80 W18766 Apollo Dr. ; Muskego, WI 53150; Toll Free Tel: 800-222-5556; Tel: 262-679-9010; Email: request_info@inprocorp.com; Web: www.inprocorp.com
- B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 MATERIALS:

- A. Vinyl: Fire retardant, high impact polyvinyl chloride (PVC), with an embossed pebbled finish.
 - 1. Minimum Thickness: 0.080 inch (2.0 mm).

2. Vinyl Properties:

- a. Surface burning characteristics, tested in accordance with ASTM E 84: Flame spread 10, smoke developed 350-450; maximum.
- b. Surface burning characteristics, tested in accordance with CAN/ULC S102.2: Flame spread 15, smoke developed 35; maximum.
- c. Self-extinguishing characteristics: CC1 classification, per ASTM D 635.
- d. Impact strength, tested in accordance with ASTM D 256: 30.2 ft lb/inch (5285 N/m) of notch, minimum.
- e. Chemical and stain resistant, as tested in accordance with ASTM D 543.
- f. Fungus and bacteria resistant, as tested in accordance with ASTM G 21 and ASTM G 22.
- g. Color consistency match when tested in accordance with SAE J-1545: Accurate to within 1.0 or less Delta E by CIE LAB 10 degree standard observer color difference and equation.

- B. Aluminum for Corner Guard Retainers: Alloy 6063-T5, in accordance with ASTM B 221; mill finish.

2.03 SURFACE MOUNTED RIGID VINYL CORNER GUARDS:

- A. InPro #160: 2-inch (50 mm) wide, 0.080-inch (2.0 mm) thick rigid vinyl cover over continuous 0.070-inch (1.8 mm) aluminum retainer.
 - 1. Provide top and bottom closure caps of injection-molded thermoplastics in color matching vinyl cover.
 - 2. Color: River Rock, 0351.

2.04 HEIGHTS:

- A. Heights: Provide corner guards in heights as follows:
 - 1. Standard 4 Feet.

2.05 ACCESSORIES:

- A. Provide appropriate fasteners and accessories as required to properly complete installation.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Verify that walls are in proper condition to receive installation of products.

3.02 PREPARATION:

- A. Clean substrate to remove dust, debris, and loose particles.
- 3.03 INSTALLATION:
- A. General: Install products level and plumb, in full compliance with manufacturer's installation instructions.
- 3.04 ADJUSTING AND CLEANING:
- A. Verify that products are plumb and rigidly secured to substrate; make any adjustments required.
 - B. Clean products and immediate areas of installation, using materials and methods recommended by manufacturer. Remove from project site packaging and debris caused by installation.

END OF SECTION

SECTION 10 28 00

TOILET & BATH ACCESSORIES

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to this section.

1.02 SUMMARY:

- A. Extent of each type of toilet accessory is indicated on drawings schedules.

- B. Types of toilet accessories required include the following:

1. Grab bars.
2. Mop and broom holders.
3. Toilet paper holders.
4. Paper towel dispensers.
5. Waste receptacles.
6. Soap dispensers.
7. Sanitary napkin disposal.
8. Shower curtain rods.
9. Shower curtains and hooks.
10. Robe hooks.
11. Shower seats.
12. Towel bars.
13. Soap Dishes.

- C. Related Sections:

1. Section 06 4023 – Interior Architectural Woodwork.
2. Section 07 9200 – Joint Sealants.
3. Section 09 2000 – Gypsum Board.
4. Section 09 3013 – Ceramic Tile.
5. Section 09 7700 – Special Wall Surfacing.

6. Section 10 2113 – Toilet Compartments.
7. Section 10 2813 – Mirror Units.
8. Division 22 – Plumbing.

1.03 QUALITY ASSURANCE:

- A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.
- B. Accessory Locations: Coordinate accessory locations, installation and sequencing with other work to avoid interference and to assure proper installation operation, adjustment, cleaning and servicing of accessory units.
- C. Single-Source Responsibility: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data for each toilet accessory item specified, including details of construction relative to materials, dimensions, gauges, profiles, method of mounting, specified options and finishes.
- B. Setting Drawings: Where cutouts are required in other work, provide templates, substrate preparation instructions, and directions for preparing cutouts and for installation of anchorage devices.

PART 2 - PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide toilet accessories by one of the following:
 1. American Specialties, Inc.
 2. Bobrick Washroom Equipment, Inc.
 3. Bradley Corporation.
- B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted, unless indicated otherwise above.

2.02 MATERIALS GENERAL:

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22-gauge minimum thickness, unless otherwise indicated.
- B. Brass: Leaded and unleaded, flat products, ASTM-B-19; rods, shapes, forgings, and flat products with finished edges, ASTM B 16, Castings, ASTM B 30.

- C. Galvanized Steel Sheet: ASTM A 527, G60.
- D. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.
- E. Galvanized Steel Mounting Devices: ASTM A 156, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.
- G. Keys: Unless otherwise indicated, provide universal keys for access to toilet accessory units requiring internal access for servicing, re-supply, etc. Provide a minimum of six (6) keys to the Owner's representative and obtain receipt.

2.03 FABRICATION:

- A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated, unobtrusive labels on surfaces not exposed to view are acceptable.

2.04 ACCESSORIES SCHEDULE:

Unit	ASI	Bobrick	Bradley
Toilet Tissue Dispenser	0715	B265	5224
Sanitary Napkin Disposal	0473-1A	B254	4722-15
Mop and Broom Holder	8215-3	B-223x24	9953
Paper Towel Dispenser	0210	B-262	250-15
Waste Receptacle	0839-T	B-2280-3	377-36
Wall-Mounted Soap Dispenser	0345	B-2112	6542
Shower Curtain Rod	1214	B-6107	953
Shower Curtain Hook	1200-SHU	204-1	9536
Shower Curtain	1200-V	204-3	9537
Robe Hook	0751	B-2116	9119-81
Shower Seat	8206	B-5181	9569
Towel Bar	755-SS18	B-673x18	9065-18
Soap Dish	7320-S	B6807	9014
Grab Bars	3800 Series	B-6806 Series	812 Series

- A. Furnish and install grab bars in accordance with the configurations shown on the drawings.
- B. Stainless steel type: Wall thickness not less than 18 gauge.
- C. Mounting: Concealed, manufacturer's standard flanges and anchorages.
- D. Clearance: 1-1/2" clearance between wall surface and inside face of bar
- E. Gripping Surfaces: Manufacturer's standard non-slip texture.
- F. Medium Duty Size: Outside diameter of 1-1/2".

PART 3 - EXECUTION:

3.01 INSTALLATION:

- A. Install toilet accessory units in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

3.02 ADJUSTING AND CLEANING:

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces after removing labels and protective coatings.

END OF SECTION

SECTION 10 28 13

MIRROR UNITS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to this section.

1.02 DESCRIPTION OF WORK:

- A. Extent of mirror units is indicated on drawings.
- B. Types of mirror units required include the following:
 - 1. Stainless steel framed mirrors.
 - 2. Frameless mirrors.
- C. Related Sections:
 - 1. Section 06 10 00– Rough Carpentry.
 - 2. Section 09 29 00 – Gypsum Board.
 - 3. Section 09 30 13– Ceramic Tile.
 - 4. Section 10 28 00 – Toilet & Bath Accessories.

1.03 QUALITY ASSURANCE:

- A. Single-Source Responsibility: Provide mirror units of same manufacturer for each type of accessory unit and for units exposed in same areas.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data, detail drawings and installation instructions for mirror units.

1.05 SPECIFIED PRODUCT WARRANTY:

- A. Provide manufacturer's written 15-year warranty against silver spoilage of mirrors, agreeing to replace any mirrors which develop visible defects within warranty period.

PART 2 - PRODUCTS:

2.01 ACCEPTABLE MANUFACTURERS:

- A. Stainless steel framed mirrors:

1. American Specialties, Inc.
 2. Bobrick Washroom Equipment, Inc.
 3. Bradley Corporation.
- B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.
- 2.02 STAINLESS STEEL FRAMED MIRRORS:
- A. Mirror Glass: 1/4" thick, first quality plate glass, triple silvered, electro-copper plated with baked enamel backing. All edges protected by plastic filler strips, back protected by 1/8" (3mm) thick polyethylene padding.
 - B. Stainless Steel Frame: Type 304, 18 gauge with bright annealed finish.
 - C. Galvanized Steel Sheet: ASTM A 527, G60, 20 gauge.
 - D. Galvanized Steel Mounting Devices: ASTM A 156, hot-dip galvanized after fabrication.
- 2.03 MIRROR UNITS:
- A. Angle-Framed Mirror:
 1. American Specialties, Inc. Model No. 0600 Series.
 2. Bobrick, Model No. B-290 Series.
 3. Bradley, Model No. 780 Series.
 - B. Mirror Sizes: As indicated on Drawings.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Verify that openings for mirrored glazing are correctly sized and within tolerance.
- B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION:

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.
- C. Prepare installation in accordance with ASTM C1193 for solvent release sealants, and install sealant in accordance with manufacturer's instructions.

3.03 INSTALLATION:

- A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.
 - B. Set mirrors plumb and level, and free of optical distortion.
 - C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
 - D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.
- 3.04 CLEANING:
- A. Remove wet glazing materials from finish surfaces.
 - B. Remove labels after work is complete.
 - C. Clean mirrors and adjacent surfaces.
- 3.05 PROTECTION:
- A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

END OF SECTION

SECTION 10 44 16

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to this section.

1.02 DESCRIPTION OF WORK:

- A. Extent of fire extinguishers, and accessories is indicated on the drawings.
- B. Definition: "Fire Extinguisher", as used in this section, refers to units which can be hand-carried, as opposed to those which are equipped with wheels, or to fixed extinguishing systems.
- C. Types of products in this section include the following:
 - 1. Fire extinguishers.
 - 2. Fire extinguisher cabinets.
 - 3. Mounting brackets.
- D. Related Sections:
 - 1. Section 06 10 00 – Rough Carpentry.
 - 2. Section 09 20 00 – Gypsum Board.
 - 3. Section 09 22 16 – Non-Structural Metal Framing.

1.03 QUALITY ASSURANCE:

- A. Single Source Responsibility: Obtain products in this section from one manufacturer.
- B. UL-Listed Products: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.
- C. FM Listed Products: Provide new portable fire extinguishers which are approved by Factory Mutual Research Corporation for type, rating, and classification of extinguisher indicated and carry appropriate FM marking.

1.04 SUBMITTALS:

- A. General: Submit the following in accordance with Conditions of Contract and Division - 1 Specification Sections.
- B. Product Data: Submit product data for each type of product specified, along with manufacturer's warranty. For fire extinguisher cabinets, include roughing-in dimensions, details showing

mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, and panel style and materials.

1. Where color selections by Owner are required, include color charts showing full range of manufacturer's standard colors and designs available.

C. Samples for initial selection purposes in form of manufacturer's color charts showing full range of colors available for those units with factory-applied color finishes.

1.05 WARRANTY:

1. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

a. Warranty Period: 6 years commencing on Date of Substantial Completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following:

1. J.L. Industries.
2. Larsen's Mfg. Co.
3. Potter-Roemer, Inc.

B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 FIRE EXTINGUISHERS:

A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard which comply with requirements of governing authorities.

1. Abbreviations indicated below to identify extinguisher types related to UL classifications and rating system and not, necessarily to type and amount of extinguishing material contained in extinguisher.

B. Multi-Purpose Dry Chemical Type: UL-rated 3-A:10:B:C, 5 lb. nominal capacity, in enameled steel container, for Class A, Class B, and Class C fires.

C. Multi-Purpose Dry Chemical Type: UL-rated 4-A: 80:B:C, 10 lb. nominal capacity, in enameled steel container with pressure indicating gauge for Class A, B and Class C fires.

2.03 MOUNTING BRACKETS:

- A. Provide brackets designed to prevent accidental dislodgment of extinguisher, of sizes required for type and capacity of extinguisher indicated, in manufacturer's standard plated finish.
 - 1. Provide brackets for extinguishers not located in cabinets and for those located in cabinets, where indicated or required.

2.04 FIRE EXTINGUISHER CABINETS:

- A. General: Provide fire extinguisher cabinets where indicated, of suitable size for housing fire extinguishers of types and capacities indicated.
- B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.
- C. Cabinet Type: Suitable for mounting conditions indicated, of the following types:
 - 1. Recessed: Cabinet box (tub) fully recessed in walls of sufficient depth to suit style of trim indicated.
- D. Trim Style: Fabricate trim in one piece with corners mitered, welded and ground smooth.
- E. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Square-Edge Trim: with 1/4" to 5/16" backbend depth.
 - a. Trim Metal: Enameled steel.
- F. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.
 - 1. Enameled Steel: Manufacturer's standard finish, hollow steel door construction with tubular stiles and rails.
- G. Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" applied to door. Provide lettering to comply with requirements indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard arrangements.
 - 1. Application Process: Engraved or Etched.
- H. Identify bracket-mounted extinguishers with red letter decals spelling "FIRE EXTINGUISHER" applied to wall surface. Letter size, style, and locations as selected by Architect.
- I. Door Style: Manufacturer's standard design.
 - 1. Bubble Type: One-piece molded clear plastic.
- J. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch, or door pull, exposed or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180°.

2.05 FINISHES FOR FIRE EXTINGUISHER CABINETS, GENERAL:

- A. Comply with NAAMM “Metal Finishes Manual” for finish designations and application recommendations except as otherwise indicated. Apply finishes in factory after products are assembled.
- B. Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering prior to shipment.

2.06 STEEL FIRE EXTINGUISHER CABINET FINISHES:

- A. Surface Preparation: Solvent-clean surfaces in compliance with SSPS-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel in compliance with SSPC-SP 5 (White Metal Blast Cleaning) or SSPC-SP 8 (Pickling).
- B. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer’s standard 2-coat baked enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer’s instructions for application and baking to achieve a minimum dry film thickness of 2.0 mils.
 - 1. Color and Gloss: As selected by Owner from manufacturer’s standard choices for color and gloss.
 - a. Exterior of cabinet, except for those surfaces indicated to receive another finish.
 - b. Interior of cabinet.

PART 3 - EXECUTION:

3.01 INSTALLATION:

- A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
 - 1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer’s instructions.
 - 2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer’s instructions.

END OF SECTION

SECTION 10 51 13

METAL LOCKERS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to this section.

1.02 SUMMARY:

- A. This section includes metal lockers and related equipment as indicated on drawings.
- B. Types of products in this section include the following:
 - 1. Standard lockers.

1.03 RELATED SECTIONS:

- A. Section 06 10 00 – Rough Carpentry.
- B. Section 06 40 23 – Interior Architectural Woodwork.
- C. Section 09 20 00 – Gypsum Board.
- D. Section 09 21 16 – Gypsum Board Shaftwall Assemblies.
- E. Section 09 22 16 – Non-Structural Metal Framing.

1.04 SUBMITTALS:

- A. Product Data: Submit manufacturer's detailed technical data and installation instructions for metal locker units
- B. Shop Drawings: Submit shop drawings that show metal lockers in dimensioned relation to adjacent surfaces. Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information.
- C. Color Samples on squares of same metal to be used for fabrication of lockers.

1.05 QUALITY ASSURANCE:

- A. Uniformity: Provide metal lockers that are standard products of a single manufacturer with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.

1.06 JOB CONDITIONS:

- A. Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage and installation.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Available Manufacturer: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
 - 1. Republic Storage Systems.
 - 2. Art Metal Products Co.
 - 3. The Interior Steel Equipment Co.
 - 4. List Industries, Inc.
 - 5. Medart, Inc.
 - 6. Penco Products, Inc.
 - 7. De Bough Mfg. Co.
- B. Section 01600-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 MATERIALS:

- A. Sheet Metal: Mild cold-rolled and leveled steel, free from buckle, scale, and surface imperfections.
- B. Expanded Metal: 3/4" mesh flattened carbon steel, 13-gauge minimum.
- C. Fasteners: Cadmium, zinc, or nickel-plated steel; exposed bolt heads, slotless type; self-locking nuts or locker washers for nuts on moving parts.
- D. Equipment: Hooks and hang rods of cadmium-plated or zinc-plated steel or cast aluminum.

2.03 FABRICATION, GENERAL:

- A. Construction: Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make all exposed metal edges safe to touch. Weld frame members together to form rigid, one-piece structure. Weld, bolt, or rivet other joints and connections as standard with manufacturer. Grind exposed welds flush. Do not expose bolts or rivet heads on fronts of locker doors or frames.
- B. Frames: Fabricate of 16-gauge channels or 12-gauge angles, minimum, with continuous stop/strike formed on vertical members.
- C. Finishing: Chemically pretreat metal with degreasing and phosphatizing process. Apply baked-on enamel finish to all surfaces, exposed and concealed, except plates and non-ferrous metal.
 - 1. Color: Provide locker units in colors as selected by Architect from manufacturer's standards. Unless otherwise indicated, concealed parts may be manufacturer's standard neutral color, Architect may require separate door color.

2.04 HEAVY DUTY VENTILATED STANDARD LOCKERS:

- A. Body: Fabricate top and bottom of not less than 16-gauge steel sheet. Fabricate back of not less than 18-gauge steel sheet. Construct sides and intermediate partitions of expanded metal welded to steel hemming.
- B. Door: Manufacturer's standard of perforated steel sheet with flanged edges, not less than 14 gauge.
 - 1. Reinforcing: Provide extra bracing or reinforcing on inside of doors over 15" wide.
 - 2. Hinges: Heavy-duty, not less than 0.050 inch thick steel, full-loop, 5-knuckle, tight pin, 2 inches high. Weld to inside of frame and secure to door with not less than 2 factory-installed fasteners that are completely concealed and tamperproof when door is closed.
 - a. Provide at least 3 hinges for each door over 42 inches high, at least 2 hinges for each door 42 inches high or less, or continuous piano hinge at top for multi-tier units.
- C. Latching: Provide mechanism as follows:
 - 1. Single-Tier Units: Three-point latching device, engaging frame at top, bottom and jamb, with chromium-plated turn handle and provisions for padlock.
- D. Handle:
 - 1. Single-Tier Units: Stainless steel recessed handle with lifting trigger and provisions for padlock.
- E. Ventilation:
 - 1. Single-Tier Units: Standard louvered doors.
- F. Size:
 - 1. Single-Tier Units:
 - a. Men: 18" width x 21" depth x 72" high.
 - b. Women: 12" width x 18" depth x 72" high.

2.05 LOCKER ACCESSORIES:

- A. Locking: Fabricate lockers to receive the following locking devices:
 - 1. Padlock: Provided by Owner.
 - a. Spring-bolt action.
- B. Equipment: Furnish each locker with the following items, unless otherwise shown:
 - 1. Single-Tier Units: One double-prong hook and not fewer than 2 single-prong wall hooks.
- C. Number Plates: Manufacturer's standard etched, embossed, or stamped, non-ferrous metal number plates with numerals not less than 3/8" high. Number lockers in sequence as directed by Architect. Attach plates to each locker door, near top, centered, with at least 2 fasteners of same finish as number plate.

- D. Continuous Sloping Tops: Not less than 20 gauge sheet steel, approximately 25° pitch, in lengths as long as practicable, but not less than 4 lockers. Provide closures at ends. Finish to match lockers.
- E. Filler Panels: Provide filler panels, of not less than 18 gauge steel sheet, factory-fabricated and finished to match locker units.

PART 3 - EXECUTION:

3.01 INSTALLATION:

- A. Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation.
- B. Space fasteners about 48" o.c., unless otherwise recommended by manufacturer, and apply through back-up reinforcing plates where necessary to avoid metal distortion; conceal fasteners insofar as possible.
- C. Install sloping top units, and metal filler panels where indicated, using concealed fasteners to provide flush, hairline joints against adjacent surfaces.

3.02 ADJUST AND CLEAN:

- A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.
- B. Touch-up marred finishes, but replace units, which cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 10 73 16
PROTECTIVE COVERS

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES:

- A. Pre-engineered, pre-finished suspended extruded aluminum canopies.
- B. Related Sections:
 - 1. Section 04 20 00 – Unit Masonry Assemblies.
 - 2. Section 05 1 200 – Structural Steel Framing.
 - 3. Section 05 31 00 – Steel Decking.
 - 4. Section 06 10 00 – Rough Carpentry.
 - 5. Section 07 62 00 – Sheet Metal Flashing & Trim.
 - 6. Section 07 92 00 – Joint Sealants.
 - 7. Section 08 41 13 – Aluminum Framed Entrances & Storefronts.

1.03 REFERENCES:

- A. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 605 - Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.

1.04 DESIGN REQUIREMENTS:

- A. Struts, Gutter Beams, Deck, and Trim: Aluminum extrusions.
- B. Structural Framing: Interlocking deck sections secured by screws.
- C. Canopy: Self-draining from deck into perimeter gutter frame through scuppers to discharge point at ground level or as otherwise shown.
- D. Building Code: International Building Code with State Amendments (latest adopted edition).
- E. Design Loads: Refer to structural drawings.
- F. Structural Design: Prepare complete structural design calculations for canopy.

1.05 SUBMITTALS:

- A. Submit under provisions of Section 01 3300 – Submittal Procedures.
- B. Product Data: Manufacturer's catalog data, detail sheets, and specifications.
- C. Shop Drawings: Layout and erection drawings showing roof framing, deck panels, cross sections, and trim details, clearly indicating proper assembly.
- D. Samples: Color selection samples consisting of actual coating material or anodizing process on aluminum extrusions.
- E. Quality Assurance/Control Submittals:
 - 1. Qualifications: Letter certifying manufacturer's required qualifications.
 - 2. Structural Design Calculations.
 - 3. Manufacturer's Installation Instructions.

1.06 QUALITY ASSURANCE:

- A. Overall Standard: Structural engineering design documents stamped by a structural engineer registered to practice in the State of Georgia.
- B. Manufacturer Qualifications: Minimum ten years experience in producing covers/canopies of the type specified.
- C. Installer Qualifications: Minimum ten years experience in erecting covers/canopies of the type specified.

1.07 DELIVERY, STORAGE, AND HANDLING:

- A. Conform to Section 01 6000 - Product Requirements.
- B. Follow manufacturer's instructions.

1.08 WARRANTY:

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
 - 1. Warranty Period: 5 years commencing on Date of Substantial Completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mapes Canopies, LLC; 7748 North 56th Street, Lincoln, NE 68514; Office: 888-273-1132; Fax: 877-455-6572; Email: canopy@mapes.com; Website: <http://mapes.com/canopies>.
 2. Peachtree Protective Covers; 1477 Rosedale Drive, Hiram, GA 30141; Office: 770-439-2120; Fax: 770-439-2122; Toll Free: 1-800-341-3325; Email: ppc@peachtreecovers.com; Website: www.peachtreecomvers.com.
 3. Perfection Architectural Systems, Inc., 2310 Mercator Drive Orlando, FL 32807; Office: 800-238-7207, Fax: 407-671-8252; Email: estimating@perfectionarch.com; Website: www.perfectionarch.com.
- B. Section 01 6000 – Product Requirements: Product selection procedures: Substitutions: Not Permitted.
- C. Provide all overhead supported canopy components from a single manufacturer.
- 2.02 MATERIALS:
- A. Aluminum Extrusions: 6063 alloy, T-6 temper.
- 2.03 COMPONENTS:
- A. Struts:
1. Aluminum tubular extrusion of size shown on shop drawings.
- B. Gutter Beam:
1. Size: As shown on shop drawings.
- C. Deck: Rigid-Roll-Lock extruded aluminum, self-flashing, interlocking sections.
1. Size and Profile: As required by structural engineering design.
- D. Flashing: Aluminum sheet, thickness as recommended by manufacturer for specific condition.
- 2.04 ACCESSORIES:
- A. Fasteners:
1. Deck Screws: No. 14 by 1 inch (25 mm), self-tapping, Type 18-8 stainless steel with neoprene washers.
 2. Trim Screws: No. 10 by 1/2 inch (13 mm), self-tapping, Type 18-8 stainless steel.
 3. Other Fasteners: Type 18-8 stainless steel, type recommended by manufacturer for specific condition.
- 2.05 FABRICATION:
- A. Shop Assembly: Fabricate with corners mitered and heli-arc welded to the extent that completed pieces can be shipped on local, state, and federal highways without special permit. Provide bolted connections for elements required to be shipped unassembled.

2.06 FINISHES:

A. Struts:

1. Fluoropolymer Coating: 70 percent PVDF resin based fluoropolymer, AA-C-12C-42R-1, custom color as selected by architect, comply with AAMA 605.
 - a. Three coat application.

B. Deck:

1. Fluoropolymer Coating: 70 percent PVDF resin based fluoropolymer, AA-C-12C-42R-1, custom color as selected by architect, comply with AAMA 605.
 - a. Three coat application.

C. Fascia/Gutter:

1. Fluoropolymer Coating: 70 percent PVDF resin based fluoropolymer, AA-C-12C-42R-1, custom color as selected by architect, comply with AAMA 605.
 - a. Three coat application.

PART 3 - EXECUTION:

3.01 EXAMINATION:

- A. Verify locations and elevations.
- B. Examine building surfaces to which canopy will connect.
- C. Coordinate with responsible trade to perform corrective work on unsatisfactory surfaces.
- D. Commencement of work by installer is acceptance of existing conditions.

3.02 ERECTION:

- A. Erect protective covers in accordance with manufacturer's installation instructions.
- B. Set plumb, straight, and true to line, adequately braced to maintain position.
- C. Keep aluminum surfaces from direct contact with ferrous metal or other incompatible materials by applying one coat of clear acrylic coating.

3.03 CLEANING:

- A. Clean surfaces soiled by work as recommended by manufacturer.
- B. Remove surplus materials and debris from the site.

3.04 PROTECTION:

- A. Protect finished aluminum surfaces from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 75 00

FLAGPOLES

PART 1 - GENERAL:

1.01 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.

1.02 SUMMARY:

- A. Extent and location of flagpoles are shown on drawings.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 05 50 00 – Metal Fabrications.
 - 3. Section 06 10 00 – Rough Carpentry.
 - 4. Division 26 – Electrical.

1.03 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical data and installation instructions for each type of flagpole required.
- B. Samples: Submit samples of each finished metal for flagpole, and accessories as may be requested.

1.04 QUALITY ASSURANCE:

- A. Manufacturers Standards: Provide flagpole as a complete unit produced by a single manufacturer, including fittings, accessories, bases, and anchorage devices.
- B. Design Criteria: Provide flagpole and installations constructed to withstand a 90 mph wind velocity minimum when flying flag of appropriate size. Use heavy pipe sizes if required for flagpole type and height shown.
- C. Pole Construction: Construct pole and ship to site in one piece, if possible. If more than one piece is necessary, provide snug-fitting, precision joints with self-aligning, internal splicing sleeve arrangement for weather-tight, hairline field joints.

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Spiral wrap flagpole with heavy Kraft paper or other protective wrapping and prepare for shipment in hard fiber tube or other protective container.
- B. Deliver flagpole and accessories completely identified for installation procedures. Handle and store flagpole to prevent damage or soiling.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
 - 1. Aabec Pole Div., Morgan-Francis Co.
 - 2. Acme Flagpole Div., Lingo, Inc.
 - 3. American Flagpole, Div. of Kearney-National
 - 4. Baartol Co., Inc.
 - 5. Concord Industries, Inc.
 - 6. Eder Flag Manufacturing Co.
- B. Section 01 6000-Product Requirements: Product selection procedures: Substitutions: Permitted.

2.02 FLAGPOLE TYPE:

- A. Aluminum Flagpole: Fabricate from seamless extruded tubing complying with ASTM B 241, alloy 6063-T6, having a minimum wall thickness of 3/16" (0.1875"), tensile strength not less than 30,000 PSI, and a yield point of 25,000 psi. Heat-treat and age-harden after fabrication.
 - 1. Provide cone tapered aluminum flagpole.
 - 2. Flagpole shall have an exposed height of 35'.
- B. Shaft Finish:
 - 1. Aluminum: Fine, directional, mechanical satin polish (NAAMM-M32), finished as follows:
 - a. Natural Clear Anodized Finish complying with NAAMM-C22A41, Class I (0.7 mil).

2.03 FLAGPOLE MOUNTING:

- A. Provide manufacturer's standard base system for the type of flagpole installation required.
- B. Foundation Tube: For ground-set flagpole, provide 16-gauge minimum galvanized corrugated steel tube, or 12-gauge rolled steel tube, sized to suit flagpole and installation. Furnish complete with welded steel bottom base and support plate, lightening ground spike, and steel centering wedges, all welded construction.
- C. Provide manufacturer's standard flash collar, finished to match flagpole.

2.04 FITTINGS:

- A. Finial Ball: Manufacturer's standard flush seam ball, size as indicated or, if not indicated, to match pole butt diameter.
 - 1. 14-gauge spun aluminum, finished to match pole shaft.

- B. Truck: Ball-bearing non-fouling, revolving, double-track assembly of cast metal, finished to match pole shaft.
- C. Cleats: One 9" cast metal cleat with fasteners, finished to match pole shaft.
- D. Halyards: Provide one continuous halyard for each flagpole, as follows:
 - 1. Nylon, braided, with metal core.
 - 2. Size: 3/8" (No. 12).
- E. Halyard Flag Snaps: Provide two chrome plated swivel snaps per halyard.

PART 3 - EXECUTION:

3.01 INSTALLATION:

- A. Excavation: Excavate for foundation concrete to neat clean lines in undisturbed soil. Provide forms where required due to unstable soil conditions. Remove wood, loose soil, rubbish, and other foreign matter from excavation, and moisten earth before placing concrete.
- B. Concrete: Provide concrete composed of Portland cement, coarse and fine aggregate, and water, mixed in proportions to attain 28-day compressive strength of not less than 3,000 psi, complying with ASTM C94.
 - 1. Place concrete immediately after mixing. Perform chuting to avoid segregation of mix. Compact concrete in place by use of vibrators. Moist-cure exposed concrete for not less than 7 days or use a non-staining curing compound in cold weather.
 - 2. Finish trowel exposed concrete surfaces to smooth, dense surface. Provide positive slope for water run-off to base perimeter.
- C. Flagpole Installation: Install flagpole as shown and in compliance with final shop drawings and manufacturer's instruction.
 - 1. Provide positive lightning ground for each flagpole installation.
 - 2. Paint portions of ground-set flagpole below grade with heavy coat of bituminous paint.

END OF SECTION

SECTION 11 53 00
LABORATORY EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installing lab equipment as scheduled or shown on the Drawings or specified herein.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications:

1. Section 11 53 13 – Laboratory Fume Hoods
2. Section 12 35 33 – Laboratory Casework and Accessories
3. Section 22 00 10 – Plumbing Systems
4. Section 22 05 29 – Hangers and Supports

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel

B. International Code Council (ICC)

1. International Plumbing Code (IPC), Latest Edition
2. Georgia Amendments to IPC

C. National Sanitation Foundation (NSF)

1. NSF/ANSI 61 - Drinking Water System Components
2. NSF/ANSI 372 - Drinking Water System Components - Lead Content

D. Underwriters Laboratories (UL)

1. UL 1951 - Standard for Safety for Plumbing Accessories

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
 - B. Product Data:
 - 1. Submit manufacturer's data for all scheduled equipment.
 - C. Shop Drawings:
 - 1. Provide installation drawings where applicable.
 - D. Maintenance Data
 - 1. Include maintenance manuals for laboratory equipment.
- 1.05 LABORATORY SUPPLY ALLOWANCE
- A. Contractor shall include an allowance in the amount of **\$50,000** for miscellaneous laboratory supplies and equipment. A list of supplies and equipment will be provided by the Owner/Engineer prior to completion of the laboratory facilities.
 - B. The allowance shall cover all materials, taxes, freight, and other related fees
 - C. The cost of equipment required for installation and the Contractor's labor, overhead, and profit shall not be included in the allowance.
 - D. Any remaining balance, after selection by the Owner, shall be deducted from the Contract amount in the final change order.
- 1.06 QUALITY ASSURANCE:
- A. Manufacturers: Equipment manufacturers shall be as noted. Alternate manufacturers will not be accepted without prior approval.
 - B. Regulatory Requirements:
 - 1. Comply with IPC, latest editions, and Georgia amendments as minimum standards.
 - 2. Where drawings and specifications exceed code, follow drawings/specifications.
 - 3. Fixtures and fittings shall be lead-free per NSF/ANSI 372 (<0.25% lead) and NSF/ANSI 61-certified for potable water.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Delivery: Ship equipment in protective packaging with proper labels.
 - B. Storage: Store indoors in dry conditions, protected from damage.

PART 2 - PRODUCTS

2.01 SPECIALTY LAB EQUIPMENT

- A. Owner to provide listing for contractor purchase after project initiation.

PART 3 - EXECUTION

3.01 GENERAL

3.02 INSTALLATION

- A. Install all equipment per manufacturer's instructions.
- B. Provide potable water or sample water supply lines where required.
- C. Provide drains to sinks or building drain, waste, and vent system where required.

END OF SECTION

SECTION 11 53 13

LABORATORY FUME HOODS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installing laboratory fume hoods

B. Supplier: One supplier/installer shall provide fume hoods and accessories specified herein and the Laboratory Casework and Accessories specified in Section 12 35 33.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications:

1. Section 11 53 00 – Laboratory Equipment
2. Section 12 35 33 – Laboratory Casework and Accessories
3. Section 22 00 10 – Plumbing Systems
4. Section 22 05 29 – Hangers and Supports
5. Division 23 – Heating, Ventilation, and Air Conditioning

1.03 REFERENCES

A. American Society for Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

1. ASHRAE 110-2016 - Method of Testing Performance of Laboratory Fume Hoods

B. Scientific Equipment and Furniture Association (SEFA)

1. SEFA 1-201 - Recommended Practices for Laboratory Fume Hoods.

C. American National Standards Institute (ANSI)

1. NSI/AIHA Z9.5-2012 - Laboratory Ventilation.

D. National Fire Protection Association (NFPA)

1. NFPA 45-2019 - Standard on Fire Protection for Laboratories Using Chemicals.

E. Underwriters Laboratories (UL)

1. UL 1805 – Laboratory Hoods and Cabinets

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
- B. Product Data:
 - 1. Submit manufacturer's technical data, including specifications, performance data, and installation instructions for fume hoods.
- C. Shop Drawings:
 - 1. Provide detailed drawings showing fume hood dimensions, service fixture locations, and exhaust connections.
- D. Test Reports:
 - 1. Submit ASHRAE 110 test results verifying fume hood containment and performance. D. Certificates: Provide documentation confirming compliance with referenced standards
- E. Operation and Maintenance Data
 - 1. Include manuals for operation, maintenance, and safety procedures.

1.05 QUALITY ASSURANCE:

- A. Manufacturers Qualifications:
 - 1. Minimum 5 years of experience in manufacturing laboratory fume hoods, with products tested to ASHRAE 110 standards.
- B. Installers Qualifications: Trained and certified by the fume hood manufacturer for proper installation with a minimum of 10 installation of equal or larger size and requirements.
- C. UL 1805 Specification:
 - 1. Fume Hood must be Underwriters Laboratories subject 1805 classified. The 1805 standard covers electrical and mechanical hazards, investigate the flammability of materials and measures the effectiveness of airflow characteristics. Proper labeling must be affixed to the face of each fume hood indicating classification to the UL 1805 standard for Laboratory Fume Hoods. UL listing covering electrical components only or other listings that do not encompass all issues covered in UL 1805 is insufficient. All factory testing shall be performed in a U.L. certified test facility
- D. Regulatory Requirements:
 - 1. Comply with OSHA, ASHRAE, SEFA, and NFPA standards for laboratory safety and ventilation.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Ship equipment in protective packaging with proper labels.
- B. Storage: Store indoors in dry conditions, protected from damage.

1.07 PROJECT CONDITIONS

- A. Do not deliver or install equipment until the following conditions have been met:
 - 1. Windows and doors are installed and the building is secure and weather tight.
 - 2. Ceiling, overhead ductwork and lighting are installed.
 - 3. All painting is completed and floor tile located below casework is installed.

PART 2 - PRODUCTS

2.01 HIGH PERFORMANCE FUME HOODS

- A. Manufacturers: BMC/Metal Arc, Kewaunee, or approved equal.
- B. General Design Requirements
 - 1. Fume hoods shall function as ventilated, enclosed workspaces, designed to capture, confine and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.
 - 2. Design fume hoods for consistent and safe air flow through the hood face. Negative variations of face velocity shall not exceed 20% of the average face velocity at any designated measuring point as defined in this section.
 - 3. Average illumination of work area with white liner: Minimum 80 foot-candles. Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 28 inches.
 - 4. Fume hood shall be designed to minimize static pressure loss with adequate slot area. Maximum average static pressure loss readings taken three diameters above the hood outlet from four points, 90 degrees apart, shall not exceed the following maximums with sash in full open position:
 - a. Face Velocity: 52 FPM
 - b. Measured SPL (W.G.): 0.19 inches
 - 5. Size: Fume hoods shall be 4' wide, unless noted otherwise on the drawings, by 35.25" deep.
 - 6. Noise Criteria: Test data of octave band analysis verifying hood is capable of a 50 NC value when connected to a 50 NC HVAC source. Reading taken 3' in front of an open sash at the 18" operational height at 100 fpm face velocity
- C. Liner Surface Finish Performance Requirements
 - 1. Fume Hood Liner shall be as recommended by the manufacturer for the type of use and location.
- D. Materials
 - 1. Steel: High quality, cold rolled, mild steel meeting requirements of ASTM A366; gauges U.S. Standard

2. Stainless steel: Type 304; gauges U.S. Standard
3. Ceiling closure panels: Minimum 18 gauge; finish to match hood exterior.
4. Safety glass: 7/32" thick laminated safety glass
5. Sash cables: Stainless steel, uncoated, 1/8" diameter military spec. quality. (MIL-W-83420D-3)
6. Sash guides: Corrosion resistant poly-vinyl chloride
7. Pulley assembly for sash cable: 2" diameter, nylon race, ball bearing type, with cable retaining device and sash leveling mechanism.
8. Sash pull: Full width extruded aluminum with chemical resistant powder coating.
9. Gaskets: Ridged black PVC for interior access panels. Gasket shall retain access panels with integral clips for easy removal and replacement of panel.
10. Fastenings:
 - a. Exterior structural members attachments: 1/4-20 machine screws and lock nuts, zinc plated
 - b. Interior fastening devices concealed. All fasteners exposed to the hood interior shall be non-metallic.
 - c. Exterior side access panel member fastening devices to be concealed. Mechanical latch, exposed screws or velcro type fasteners – not acceptable.
11. Instruction plate: Corrosion resistant or plastic plate attached to the fume hood exterior with condensed information covering recommended locations for apparatus and accessories, baffle settings and use of sash.

E. Construction

1. Superstructure: Rigid, self supporting assembly of double wall construction, maximum 5" thick.
 - a. Wall consists of a sheet steel outer shell and a corrosion resistant inner liner, and houses and conceals steel framing members, attaching brackets and remote operating service fixture mechanisms and services. Panels must be attached to a full frame construction, minimum 16 gauge painted members.
 - b. Access to fixture valves concealed in wall provided by exterior removable access panels and gasketed access panels on the inside liner walls.
2. Exhaust outlet: Round, 18 gauge stainless steel
3. Access opening perimeter: Air foil or streamlined shape with all right angle corners radiused. Bottom horizontal foil shall be double tiered and provide nominal one inch bypass when sash is in the closed position. Bottom foil shall not be removable without use of special tools. Bottom foil shall provide access area sufficient in size to pass thru electrical plugs. Bottom foil: Steel with powder coated finish.

4. Fume hood sash: (Combination) Vertical and horizontal sash access with a 35" high sight line. Sash shall be top hung on nylon tired ball bearing wheels. Sash side frame must be inset into sash guides providing a full width unobstructed view of the interior. Exposed side frames - not acceptable. Upper and lower sash frame components to be extruded aluminum. Lower frame radiused to minimize turbulence and have integral guides for horizontal sliding panels. Area above the 27 1/2" vertical sash opening shall be glazed with laminated safety glass. All glass to have finished edge treatment. Horizontal panels provided with finger pulls.
5. Counter balance system: Single weight, pulley, cable, counter balance system which prevents sash tilting and permits one finger operation at any point along full width pull. Maximum 7 pounds pull required to raise or lower sash throughout its full length of travel. Design system to hold sash at any position without creep and to prevent sash drop in the event of cable failure.
6. Sash lock: Keyed sash lock to prevent the sash from opening above 18" without being unlocked. Sash shall be able to be locked at any position, even above 18", and reset when lowered below 18".
7. Airfoil: The airfoil will be flush to the worksurface with ample room for electrical cords to fit between the airfoil and sash handle. Sill to be aerodynamically radiused on front edge and have a secondary containment trough.
8. Fume hood liner: Resin-chem: Reinforced polyester panel; smooth finish and white color in final appearance. Flexural strength: 19,500 psi. Flame spread: 19 or less per ASTM E84. Baffle must be same material as liner. Metallic baffles, brackets or supports on hood interior are not acceptable. Liner and baffle material must meet 1.03 performance test.
9. Baffles: Baffles providing controlled air vectors into and through the fume hood must be fabricated of the same material as the liner. High performance baffles must be mathematically calculated to provide proper energy distribution of exhaust currents providing stable performance regardless of sash position. Baffle to be non-adjustable. Baffles with manual or automatic adjustment are not acceptable. All baffles, supports, and brackets to be non-metallic.
10. Sash Position: Sash shall be designed to promote usage as an upper body and face shield. Face velocities and volumes shall be based on an 18" operating opening. Sash shall have the capability to be raised to full 27.5" vertical opening for loading or unloading of large apparatus. A keyed lock shall be provided limiting the sash operation to 18".
11. Service fixtures and fittings: Color coded hose nozzle outlets and valves mounted inside the fume hood and controlled from the exterior with color coded index buttons:
 - a. Valves: Needlepoint type with self-centering cone tip and seat of hardened stainless steel. Tip and seat shall be removable and replaceable.
 - b. Provide piping for all service fixtures from valve to outlet and from valve to a point 3" above or below the superstructure as indicated by project conditions: Copper for water, air and vacuum and black iron for gas services.
 - c. Fixtures exposed to hood interior: Color coded chemically resistant nylon

- d. Remote control handles: Black nylon four-arm handle with nylon color-coded index buttons.
 - e. Services: As shown or specified.
- 12. Hood light fixture: Two lamp, instant start, UL listed, T8 fluorescent light fixture with sound rated "A" ballast installed on exterior of roof. Provide safety glass panel cemented and sealed to the hood roof.
 - a. Interior of fixture: White, high reflecting plastic enamel.
 - b. Size of fixture: Largest possible up to 48" for hoods with superstructures up to six feet. Provide two 24" fixtures for hoods with eight foot superstructures.
 - c. Include lamps with fixtures. Hoods without lamps are not acceptable
 - d. Illumination: Per the General Performance Requirements section.
 - e. Access to light from top front of hood.
- 13. Electrical services: Three wire grounding type receptacles rated at 120 V.A.C. at 20 amperes. Flush plates: Stainless steel.
- 14. Wiring: Pre-wire electrical fixtures to junction box located on top of hood.
- 15. Work surfaces: 1-1/4" thick surface, dished a nominal 3/8" to contain spills.
 - a. Molded resin work surfaces for hoods with Resin-Chem liners
- 16. Safety Monitor/Alarm System. Provide Safety Monitor/Alarm System which monitors face velocity and provides audible and visual alarm if face velocity drops below safe levels. The technology used in the alarm will be based on thermally compensated thermistor based in the alarm module.
 - a. Safety monitor: UL listed, tamper proof, with all alarm circuits, electric components, external tubing, and manifolds furnished complete and factory installed. The monitor shall have a visual display which provides clear indication of airflow conditions.
 - b. Calibration is required once the hood is stationed and the hood exhaust and room supply systems are balanced. A secondary calibration has been factory set into the alarm's memory only to determine that the alarm is functional and ready for shipment. The primary calibration must be completed in the field.
 - c. Airflow sensor: Thermally compensated glass-beaded thermistor, factory connected to a side-wall port on the interior of the fume hood.
 - d. Alarm Signal: Audible and visual signal:
 - 1) Silence pushbutton, which disables the audible alarm, shall be accessible on the front of the safety monitor.
 - 2) When alarm condition is corrected and face velocity and volume return to specified levels, the Safety Monitor will automatically reset and begin routine monitoring.

- e. Provide test circuit to verify proper Safety Monitor operation.
- f. Electrical rating: Maximum 12 VDC.

F. Metal Finish

1. Metal Finish

- a. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pre-treat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.
- b. Application: Electrostatic application of epoxy powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high-grade laboratory furniture quality finish with a 1.5 mil average thickness.

2. Surface Finish Tests

- a. Independent, third party performance testing must be submitted validating compliance and adheres to the finish specifications. The following test must be included:
 - 1) Chemical Spot Test: Test resistance to typical reagents found in water treatment laboratories.
 - 2) Hot Water Test: Verify coating is resistant to hot water.
 - 3) Impact Test: Evaluate durability of finish to show no cracks or checks when impacted by a one-pound, 2" ball dropped from a distance of 12".
 - 4) Paint Adhesion on Steel Test: Test per ASTM D2197-86.
 - 5) Paint Hardness on Steel Test: Determine resistance to scratching by objects with hardness up to an equivalent of 4-H pencil lead.

G. Source Quality Control Testing

- 1. Evaluation of manufacturer's standard product shall take place in manufacturer's own test facility, with testing personnel, samples, apparatus, instruments, and test materials supplied by the manufacturer at no cost to the Owner.
- 2. Submit test report for each hood width and configuration specified demonstrating the hood achieves a rating of 4.0 AM 0.05 PPM or better. Tested to ASHRAE-110-1995. Test shall be done with sash open 27.5" vertically at 52 fpm face velocity.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation

- 1. Install all equipment per manufacturer's instructions.

2. Install equipment plumb, square, and straight with no distortion and securely anchored as required.
3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.
4. Install accessories and fittings in accordance with manufacturer's recommendations.
5. Connect to exhaust system and utilities as specified in related sections.

3.02 ADJUSTING AND TESTING

- A. Adjust sash, fixtures, accessories and other moving or operating parts to function smoothly.
- B. Test and balance exhaust system to ensure proper airflow and containment. Coordinate with HVAC contractor as required.

3.03 CLEANING

- A. Clean equipment, touch up as required.

3.04 DEMONSTRATION

- A. Train owner's personnel on operation, maintenance, and safety procedures for fume hoods.
- B. Demonstrate proper use of sash, service fixtures, and airflow monitor

3.05 PROTECTION OF FINISHED WORK

- A. Provide all necessary protective measures to prevent exposure of equipment from exposure to other construction activity.
- B. Advise contractor of procedures and precautions for protection of material and installed fume hoods from damage by work of other trades

.

END OF SECTION

SECTION 12 35 53

LABORATORY CASEWORK AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installing laboratory casework and accessories including but limited to
 - a. Metal (Steel) Casework
 - b. Laboratory countertops
 - c. Laboratory sinks, faucets, and appurtenances
 - d. Laboratory casework accessories including hinges, pulls, locks, and supports
- B. Supplier: One supplier/installer shall provide casework and accessories specified herein and the Laboratory Fume Hoods specified in Section 11 53 13.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications:
 1. Section 11 53 00 – Laboratory Equipment
 2. Section 11 53 13 – Laboratory Fume Hoods
 3. Section 22 00 10 – Plumbing Systems
 4. Section 22 05 29 – Hangers and Supports
 5. Section 22 40 00 – Plumbing Fixtures
 6. Section 10 28 00 – Toilet and Bath Accessories
 7. Section 22 26 19 – Processed Water Equipment for Laboratory Facilities

1.03 REFERENCES

- A. Scientific Equipment and Furniture Association (SEFA)
 1. SEFA 1 - Installations
 2. SEFA 3– Laboratory Work Surfaces
 3. SEFA 8M– Laboratory Grade Metal Casework

4. SEFA 13 – Vertical Exhausting Laminar Flow Hoods
- B. National Fire Protection Act (NFPA)
 1. NFPA 30 – Flammable and Combustible Liquid Code
 2. NFPA 45 – Standard on Fire Protection for Laboratories Using Chemicals
- C. American Society for Testing and Materials (ASTM):
 1. ASTM D522 – Standard Test Method for Mandrel Bend Test of Attached Organic Coatings
- D. American National Standards Institute (ANSI)
 1. ANSI/ASHRA 110 - Method of Testings Performance of Laboratory Fume Hoods
- E. International Code Council (ICC)
 1. International Plumbing Code (IPC), Latest Edition
 2. Georgia Amendments to IPC
- F. US Department of Justice
 1. ADA Standards for Accessible Design
- G. Underwriters Laboratories (UL)
 1. UL 1805 – Standard for Laboratory Fume Hoods and Ventilation
 2. UL 1951 - Standard for Safety for Plumbing Accessories
- 1.04 SUBMITTALS
 - A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
 - B. Product Data
 1. Submit manufacturer's data and installation instructions for each type of casework.
 2. Submit fume hood data including duct connections, sash operation, and baffle configurations.
 - C. Shop Drawings
 1. Submit shop drawings for furniture assemblies showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fittings
 - a. Coordinate shop drawings with other work involved
 - b. Provide roughing-in drawings for mechanical and electrical services when required
 2. Samples
 - a. Provide manufacturers color charts

- 1) Provide 12" x 12" samples of powder coated steel in the Owner's selected colors. A maximum of three different colors may be required for Owner's final selection..

- b. Provide minimum 6"x6" samples of countertop and backsplash material.

D. Maintenance Data

1. Include operation and maintenance manuals for fume hoods, faucets, and other similar equipment.

1.05 QUALITY ASSURANCE:

1. Casework manufacturer shall have a minimum of 10-years' experience producing specified casework and appurtenances.

- B. The laboratory casework, worktops, fume hoods, and accessories shall be supplied by one contractor/manufacturer.

- C. General Performance: Provide certification that furniture shall meet the performance requirements described in SEFA 8.

- D. Finish Performance: Provide independent test lab certification that furniture shall meet the performance requirements described in these specifications.

E. DELIVERY, STORAGE, AND HANDLING

- F. Delivery: Ship casework, countertops, and fume hoods in protective packaging, labeled with component type and location.

1. Contractor shall note freight damage on Bill of Lading and report to supplier immediately.

G. Storage

1. Store casework in a dry, ventilated area, vertically or flat with foam spacers to prevent scratching
2. Store countertop panels horizontally with styrofoam spacers, indoors, with protective film intact, per manufacturer's instructions.
3. Store fume hoods upright in a dry area, with sashes secured and liners protected from abrasion.

H. Handling

1. Use proper lifting equipment for heavy steel casework, countertops, and fume hoods.
2. Handle fume hood sashes and liners with care to prevent damage to glass or chemical-resistant coatings

1.06 WARRANTY

1. Manufacturer shall warrant that all products be free of defects in material and workmanship for a period of one year.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 - PRODUCTS

2.01 STEEL LABORATORY CASEWORK

- A. Manufacturers: Acceptable manufacturers include BMC/Metal-Arc+, Kewaunee Scientific Corporation, or approved equal.
- B. Style: All casework doors and drawers shall be inset style with stainless steel wire pulls and institutional 5-knuckle hinges
- C. Materials:
- D.
 - 1. Material: Cabinet bodies, drawer bodies, shelves, drawer heads and door assemblies shall be fabricated from cold rolled steel, prime grade or better.
 - 2. Construction: All welded construction shall be used throughout except where construction details make it impossible. Welded joints shall be ground flush with adjacent materials and neatly polished. No bolts, rivet heads, screws or other fastening devices shall be visible on any exposed surface. Where units are joined in assemblies, they shall be fastened by bolting through pierced cabinet sides.
 - 3. Base Cabinets:
 - a. Construction: Cabinets shall be constructed of prime 18-gauge steel for the sides, backs, and toe space. 1" X 18-gauge steel tubing shall be used for the top front and back rails. Each front joint is to be welded and ground flush to provide a smooth surface. A 4' high by 3' deep toe space shall be standard. Four corners are to be fitted with a stamped and welded 14 gauge leveling gusset plate, and a plated leveling screw. Leveling screws are provided with a slot for easy adjustment, and non-marking nylon glides. Removable back panels shall be furnished on all cabinets. Cabinet bottom will be panned up to contain spills and removable for easy cleaning and maintenance
 - b. Doors: All metal doors shall be reinforced, double-wall construction with an outer panel of 18 gauge and an inner panel of 20-gauge steel. Both inner and so that the outer panels shall be pan shaped and held tightly together so that the outer panel of the door has no visible seam welded. All hinged doors shall be slotted to receive hinges, and all metal doors shall be filled with sound deadening material to insure operation. Doors shall close on rubber or nylon bumpers.
 - c. Drawers: Drawer bodies shall be 20-gauge steel. Drawer heads shall be box tight construction with outer pan fabrication of 18-gauge steel and inner pan 20-gauge steel. Drawer heads shall be sound deadened with fiberglass.

- 1) Drawers shall operate on full extension, ball bearing, zinc plated, drawer suspension rated to withstand 10,000 cycles at 100 lbs.
 - d. Shelves: Shelves shall be constructed of 18-gauge steel, with channels formed on both the front and back edges. K & V shelf clips are made from 14-gauge steel, and are to be adjustable vertically in 1" increments. Sliding shelves shall use the same ball bearing slides as drawer units.
 - e. Fabricated Accessories: Fabricated Accessories All accessories required for specific installations shall be fabricated and finished to the same material and quality standards as the base units they will be made to compliment.
 - f. Cabinet Height: Cabinet height shall be as scheduled or detailed on the drawings.
4. Special Purpose Storage Cabinets
- a. Acid Storage Fume Hood Cabinets: Acid storage fume hood cabinets shall utilize the same gauges of steel and construction features as other base cabinets except they shall be completely lined with a one-piece polyethylene corrosion resistant liner. The liner shall be 1/4" thick, molded into a seamless tub, including top, sides and bottom, with a 1" lip at the bottom front to contain spills. Tubs shall include integral cleats at both ends and back to support an optional shelf. Each door shall have a set of louvers at the top and bottom, and have a 1/8" sheet polyethylene liner. Where specified, each cabinet shall be vented into the fume hood with a 1-1/2" vent pipe allowing a positive airflow directly into the fume hood exhaust system. When specified or shown on drawings, cabinet shall include a full-depth phenolic resin.
 - b. Solvent Storage Cabinets: Solvent storage cabinets shall be specifically designed for the storage of flammable and combustible liquids. Construction shall be based upon the requirements listed by UFC, OSHA and NFPA No. 30 - 1993, and cabinets shall be FM approved and labeled. The bottoms, top, sides and doors shall be fabricated of 18 gauge steel and shall be all double panel construction with a 1-1/2" air space between panels. All joints shall be welded, or screwed, to provide a rigid enclosure. The doors shall swing on full-length stainless steel piano hinges and shall be fully insulated. The doors are self-closing and synchronized so that both doors will always fully close. The right hand door is equipped with a three-point latching system that automatically engages when the doors close. Each door is equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit. Units 24" long have only one door, self-closing, and equipped with a three-point latching system and hold-open feature. A 2" deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills. A second pan shall be provided to serve as a full-depth adjustable shelf. Two, 2" diameter, diametrically opposed vents with spark screens shall be provided in the back of the cabinet as well as a grounding screw. The cabinet shall have interior finish same as exterior. The cabinet shall be labeled: "FLAMMABLE - KEEP FIRE AWAY.
 - c. Vacuum Pump Cabinets: Vacuum pump cabinets shall utilize the same gauges of steel and construction features as other base cabinets except they shall be provided without a bottom to allow vacuum pumps and other equipment to be rolled in and out of the cabinet. The interior of the cabinet shall be lined with a 1-inch thick neoprene foam for sound deadening and easy cleaning. Each cabinet shall be furnished with a 120 VAC,

20 amp, duplex receptacle mounted on the inside cabinet back and a pilot lighted toggle switch mounted in the top front panel. Each cabinet shall be furnished with a 1½" diameter PVC vent pipe in the back for venting or access to the fume hood above. The toe kick shall be attached to the doors and shall allow total access to the front of the cabinet. Internal wiring from the switch and pilot light to the receptacle shall not be furnished unless otherwise specified.

5. Upper Wall Cabinets

- a. Wall cabinets shall be made to the same material and quality standards as base units.
- b. Upper cabinets shall have a completely finished interior same as exterior and shall be designed so that no mounting hardware is visible when installed.

E. Finish:

1. All surfaces shall be painted or plated, whether they are exposed or not. Paint is to be a chemically resistant baked on epoxy powder coat enamel.
2. Cabinet finish shall be tested in accordance with SEFA 8-M, Section 8.0.
3. All under counter appliances shall be painted to match the frame color of the laboratory furniture unless noted otherwise.

F. Performance Requirements

1. Base cabinets shall be constructed to support at least a uniformly distributed load 200 pounds per square foot of cabinet top area, including working surface without objectionable distortion or interference with door and drawer operation.
2. Base cabinet leveling bolts shall support 500 pounds per corner, at 1-1/2" projection of the leveling bolt below the cabinet bottom.
3. Each adjustable and fixed shelf 4 feet or shorter in length shall support an evenly distributed load of 40 pounds per square foot up to a maximum of 200 pounds, with nominal temporary deflection, but without permanent set.
4. Full extension soft-close, self-closing ball bearing zinc plated drawer slide shall be rated for 100 pound loads.
5. Swinging doors on floor-mounted inset style casework shall support 200 pounds suspended at a point 12" from hinged side, with door swung through an arc of 160 degrees. Weight load test shall allow only a temporary deflection, without permanent distortion or twist. Door shall operate freely after test and assume a flat plane in a closed position.
6. Casework performance shall be tested in accordance with SEFA-8-M

2.02 COUNTERTOPS (WORK SURFACES)

A. Basis of Design: Trespa® TopLab® PLUS.

1. Equal products from other manufacturers will be accepted.

B. Material and Construction:

1. Compact, homogeneous high-pressure laminate sheets (also known as phenolic resin panels) consisting of layers of natural fibers (wood) impregnated with phenolic resins and acrylic-based surface layers, having decorative colors or designs, acrylic clear surface coat, and cured with manufacturer's Electron Beam Curing (EBC) method.
2. Panel Core: Manufacturer's standard black core
3. Thickness: 1 inch unless noted otherwise on the drawings.
4. Size: Countertop depth shall be as indicated on the drawings.
5. Edge Profile: Marine edge unless indicated otherwise on the drawings

C. Panel Attributes:

1. Easy machineability.
2. Scratch resistance.
3. Impact resistance.
4. Chemical resistance.
5. Resistance to many aggressive cleaning chemicals.
6. Does not support bacterial growth.

D. Fabrication:

1. Fabricate solid phenolic panels according to manufacturer's recommendations and approved submittals.
2. Fabricate panels, edges, drip grooves, and other shapes to design profiles on Drawings.
3. Form tight-fitting butt joints in the work surface using two part epoxy adhesive, or mechanical fasteners positioned to be concealed after installation.
4. Bond and seal curbs to the top of the work surface to form a square joint.
5. Cutouts for sinks, fixtures, or other purposes per the item manufacturer's recommendation and panel manufacturer recommendations.

E. Backsplash: 4" high, coved, bonded with chemical-resistant adhesive.

1. Provide similar Side Splash where adjacent to walls.

2.03 LABORATORY SINK

A. Location: Provide laboratory sinks where scheduled or indicated on the drawings.

B. Fixture

1. Material: Monolithic, cast epoxy resin sink, molded and oven-cured for maximum chemical and heat resistance, non-porous, and anti-microbial

2. Type: Undercounter mount unless otherwise scheduled or shown on the drawings.
3. Size: As scheduled or noted on the drawings.
4. Features: Coved inside corners and bottom pitched to drain outlet.

C. Faucets

1. Mixing Faucets:

- a. Type: Deck mounted faucet with vacuum breaker and wrist blade handles for hot and cold water
- b. Body: Forged Brass
- c. Valve Unit: Water Saver self-contained compression valve unit with replaceable stainless-steel seat.
- d. Handle: Forged brass wrist blade handles with color-coded index disc
- e. Gooseneck: 6" rigid/swing gooseneck. Gooseneck is set in right-hand configuration unless otherwise specified.
- f. Vacuum Breaker: Integral vacuum breaker to prevent backflow. Vacuum breaker shall have replaceable seat and ultra-light float cup to resist spilling at low flow.
- g. Inlet: 1-3/16" male shank with (2) 3/8" OD flexible copper tubes. Furnished complete with locknut and washer.
- h. Outlet: 3/8" NPS female outlet with removable anti-splash serrated hose end.
- i. Manufacturer: WaterSaver L414VB-BH or equal

2. Sample Faucets:

- a. Type: Deck mounted faucet with vacuum breaker and single wrist blade handle
- b. Body: Forged Brass
- c. Valve Unit: Water Saver self-contained compression valve unit with replaceable stainless-steel seat.
- d. Handle: Forged brass wrist blade handle with color-coded index disc
- e. Gooseneck: 6" rigid/swing gooseneck. Gooseneck is set in right-hand configuration unless otherwise specified.
- f. Vacuum Breaker: Integral vacuum breaker to prevent backflow. Vacuum breaker shall have replaceable seat and ultra-light float cup to resist spilling at low flow.
- g. Inlet: 3/8" NPT male inlet. Furnished complete with locknut and washer.
- h. Outlet: 3/8" NPS female outlet with removable anti-splash serrated hose end.
- i. Manufacturer: WaterSaver L611VB-BH or equal

D. Accessories:

1. P-Trap Assembly: SCH 40 Polypropylene, chemical resistant, flame retardant. Blueline by Orion or equal

2.04 LABORATORY ACCESSORIES

A. Pegboard (Bottle Rack) – Wall Mounted

1. Wall mounted, phenolic resin pegboard 32" wide by 30" high with Fifty-three polypropylene pegs unless otherwise scheduled or noted on the drawings.

2.05 BOTTLE WASHER

A. Refer to Section 22 40 00, Plumbing Fixtures

2.06 SAFETY SHOWERS AND EYEWASH STATIONS

A. Refer to Section 22 40 00, Plumbing Fixtures

PART 3 - EXECUTION

3.01 SITE EXAMINATION

- A. The Contractor and/or his Installer shall assure all building conditions conducive to the installation of a finished goods product; all critical dimensions and conditions previously checked have been adhered to by other trades (general, mechanical, electrical, etc.) to assure a quality installation.

3.02 CASEWORK AND WORKSURFACES

A. Preparation

1. Provide blocking and other additional supports as required during wall construction as required for casework installation.
2. Prior to beginning installation of casework, check and verify that no irregularities exist that would affect quality of execution of work specified.

B. Coordination

1. Coordinate the work of the Section with the schedule and other requirements of other work being prepared in the area at the same time both with regard to mechanical and electrical connections to and in the fume hoods and the general construction work.

C. Installation:

1. Casework

- a. Set casework components plumb, square, and straight with no distortion and securely anchor to building structure. Shim as required using concealed shims.
- b. Bolt continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.

- c. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.
 - d. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8".
2. Worksurfaces
- a. Where required due to field conditions, scribe to abutting surfaces.
 - b. Only factory prepared field joints, located per approved shop drawings, shall be permitted. Secure the joints in the field, where practical, in the same manner as in the factory.
 - c. Secure worksurfaces to leveled casework and equipment components with materials and procedures recommended by the manufacturer.
 - d. Install backsplashes/side splashes with coved joints, sealed with chemical-resistant caulk.
 - e. Coordinate sink cutouts with epoxy sink installation ensuring 1/8-inch overhang for undermount sinks.
 - f. Attach sinks using manufacturer approved, chemical resistant, adhesive. Ensure water tight fit.
3. Adjust and Clean
- a. Repair or remove and replace defective work, as directed by Engineer upon completion of installation.
 - b. Adjust doors, drawers and other moving or operating parts to function smoothly.
 - c. Clean shop finished casework; touch up as required.
 - d. Clean worksurfaces and leave them free of all grease and streaks.
 - e. Casework to be left broom clean and orderly.
4. Protection
- a. Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.
 - b. Advise owner and/or his representative of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades

END OF SECTION

SECTION 12 50 00

FURNITURE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Providing Office Furniture as selected by the Owner.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications:

1. Division 10 - Specialties
2. Section 11 53 00 – Lab Equipment
3. Section 11 53 13 – Laboratory Fume Hoods
4. Section 12 35 33 – Laboratory Casework and Accessories

1.03 REFERENCES

- A. ANSI/BIFMA X5.1 – General-Purpose Office Chairs – Tests.
- B. ANSI/BIFMA X5.5 – Desk Products – Tests.
- C. ANSI/BIFMA X5.9 – Storage Units – Tests.
- D. ISO 24496 – Office Furniture – Office Chairs – Methods for Determination of Dimensions.
- E. NFPA 701 – Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- F. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

1. Provide manufacturer's catalogs, as selected by the Owner, for product selection.

1.05 ALLOWANCE:

- A. Contractor shall include an allowance in the amount of **\$75,000** for the purchase of Office Furniture and accessories. A list of furniture and accessories will be provided by the Owner/Engineer for purchase by the Contractor.
- B. The allowance shall cover all materials, taxes, freight, and other related fees

- C. The cost of equipment required for installation and the Contractor's labor, overhead, and profit shall not be included in the allowance.
- D. Any remaining balance, after selection by the Owner, shall be deducted from the Contract amount in the final change order.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver furniture in manufacturer's original packaging, labeled with product details.
- B. Store furniture in a dry, climate-controlled environment, protected from damage.
- C. Handle furniture to prevent scratches, dents, or upholstery damage

PART 2 - PRODUCTS

A. FURNITURE AND ACCESSORIES

- 1. Furniture and accessories shall be of the manufacturer, model, type, and color as selected by the Owner.

PART 3 - EXECUTION

3.01 GENERAL

3.02 INSTALLATION

- A. Assemble and install all furniture and accessories per the manufacturer's instructions.
 - 1. Assemble components, where required, securely, ensuring stability and alignment.
- B. Locate furniture and accessories as directed by the Owner or Engineer.
- C. Adjust chairs, desks, and accessories to user specifications
- D. Connect power or data systems where required.

3.03 CLEANING AND PROTECTION

- A. Clean furniture surfaces per manufacturer's instructions, removing dust and fingerprints.
- B. Protect installed furniture from damage during remaining construction activities.
- C. Provide temporary covers for upholstery and surfaces, if required.

END OF SECTION

SECTION 13 34 00

FABRICATED ENGINEERED STRUCTURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Custom-sized, prefabricated building with 1/8-inch Fiberglass Reinforced Plastic (FRP) skin and foam core sandwich panel construction.
2. Exhaust fan with louver for ventilation.
3. Electric heater with thermostat for climate control.
4. Associated accessories, including mounting hardware, insulation, and structural reinforcements.

B. Related Sections:

1. Section 07 21 00 - Thermal Insulation: For additional insulation requirements.
2. Section 23 30 00 - HVAC Power Ventilators: For exhaust fan performance criteria.

1.02 REFERENCES

A. ASTM International (ASTM):

1. ASTM C 991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings.
2. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
3. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. Underwriters Laboratories (UL):

1. UL 2021 - Standard for Fixed and Location-Dedicated Electric Room Heaters.

1.03 SUBMITTALS

- ###### **A. Product Data:** Submit manufacturer's product data for FRP foam core panels, exhaust fan, louver, and heater, including performance characteristics, dimensions, and installation instructions.

- B. Shop Drawings: Provide detailed drawings showing:
 - 1. Building dimensions and panel layout and color selections.
 - 2. Exhaust fan, louver, and heater details.
 - 3. Structural reinforcement details.
 - 4. Electrical and mechanical connections.
 - C. Certificates: Submit certification that materials meet specified standards, including ASTM E 84 for flame spread and smoke development.
 - D. Warranty: Submit manufacturer's warranty for materials and components.
- 1.04 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Minimum 5 years of experience in fabricating FRP foam core structures and related mechanical systems.
 - B. Installer Qualifications: Certified by the manufacturer for installation of prefabricated structures and HVAC components.
 - C. Regulatory Requirements: Comply with local building codes and ASHRAE 90.1 for energy efficiency.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in manufacturer's original packaging with labels intact.
 - B. Store materials in a dry, covered area, protected from weather and damage.
 - C. Handle panels and components to prevent damage to FRP skin or foam core.
- 1.06 WARRANTY
- A. Provide manufacturer's standard warranty:
 - 1. FRP Foam Core Panels: Minimum 10 years against delamination and corrosion.
 - 2. Exhaust Fan and Louver: Minimum 5 years.
 - 3. Electric Heater: Minimum 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers (Subject to compliance with requirements):
 - 1. Fiberglass Foam Core Panels: Plasti-Fab, or approved equal.
 - 2. Exhaust Fans: See Section 23.

3. Louvers: See Section 23, Greenheck, or approved equal.
4. Electric Heaters: See Section 23.

2.02 FABRICATED BUILDING - FRP FOAM CORE PANELS

- A. Description: Custom-sized, prefabricated building constructed from FRP foam core sandwich panels with integral insulation, designed for durability, thermal performance, and corrosion resistance.
- B. Panel Construction:
 1. Skin: 1/8-inch (3.2 mm) thick thermoset FRP sheet, UV-resistant, with a smooth exterior finish.
 2. Core: Closed-cell foam (XPS, PET, or PU) with a minimum density of 30 kg/m³, providing thermal conductivity less than 0.03 W/m·K.
 3. Panel Thickness: Minimum 2 inches (50.8 mm) or as required for R-value of 7.2 minimum.
 4. Structural Reinforcements: Embedded wood, metal, or plastic components to prevent deformation and facilitate mounting.
 5. Assembly: Compression-molded with high-quality adhesive to bond skin and core.
- C. Dimensions: Custom-sized as indicated on drawings, with a minimum roof height of 7 feet at the peak.
- D. Door: 36-inch x 78-inch FRP door with corrosion-resistant hardware and a 17-inch x 17-inch shatterproof window and interior door opening hardware.
- E. Mounting: Provide gasket and mounting flanges for direct setting on a concrete slab and attachment to vertical slab. Three walled enclosures with roof and no floor are acceptable. whe. Include removable lifting eyes for installation.

END OF SECTION

SECTION 14 24 00

MACHINE ROOM-LESS HYDRAULIC PASSENGER ELEVATORS

PART 1 - GENERAL:

1.01 SUMMARY:

A. Section includes: Hydraulic passenger elevators as shown and specified. Elevator work includes:

1. Standard pre-engineered hydraulic passenger elevators.
2. Elevator car enclosures, hoistway entrances and signal equipment.
3. Operation and control systems.
4. Jack(s).
5. Accessibility provisions for physically disabled persons.
6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.
7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:

1. Division 3 - Concrete: Installing inserts, sleeves, and anchors in concrete.
2. Division 4 - Masonry: Installing inserts, sleeves, and anchors in masonry.
3. Division 5 - Metals:
 - a. Providing hoist beams, pit ladders, steel framing, auxiliary support steel and divider beams for supporting guide-rail brackets.
 - b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.
4. Division 9 - Finishes: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.
5. Division 22 - Plumbing:
 - a. Sump pit and oil interceptor.
6. Division 23 - Heating, Ventilation and Air Conditioning
 - a. Heating and ventilating hoistways and/or control room.
7. Division 26 - Electrical:
 - a. Providing electrical service to elevators, including fused disconnect switches.
 - b. Emergency power supply, transfer switch and auxiliary contacts.

- c. Heat and smoke sensing devices.
 - d. Convenience outlets and illumination in machine room, hoistway and pit.
- C. Work Not Included: General contractor shall provide the following in accordance with the requirements of the Model Building Code and ANSI A17.1 Code. For specific rules, refer to ANSI A17.1, Part 3 for hydraulic elevators. State or local requirements must be used if more stringent. The cost of this work is not included in elevator proposal since it is a part of the building construction.
1. Elevator hoist beam to be provided at top of elevator shaft. Beam must be able to accommodate proper loads and clearances for elevator installation and operation.
 2. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports and bracing including all setting templates and diagrams for placement.
 3. Hatch walls require a minimum two hours of fire rating. Hoistway should be clear and plumb with variations not to exceed 1/2" at any point.
 4. Elevator hoistways shall have barricades, as required.
 5. Install bevel guards at 75° on all recesses, projections or setbacks over 2" (4" for A17.1 2000 areas) except for loading or unloading.
 6. Provide rail bracket supports at pit, each floor and roof. For guide rail bracket supports, provide divider beams between hoistway at each floor and roof.
 7. Pit floor shall be level and free of debris. Reinforce dry pit to sustain normal vertical forces from rails and buffers.
 8. Where pit access is by means of the lowest hoistway entrance, a vertical ladder of non-combustible material extending 42" minimum, (48" minimum for A17.1-2000 areas) shall be provided at the same height, above sill of access door or handgrips.
 9. All wire and conduit should run remote from the hoistways.
 10. When heat, smoke or combustion sensing devices are required, connect to elevator control cabinet terminals. Contacts on the sensors should be sided for 12-volt D.C.
 11. Install and furnish finished flooring in elevator cab.
 12. Finished floors and entrance walls are not to be constructed until after sills and door frames are in place. Consult elevator contractor for rough opening size. The general contractor shall supply the drywall framing so that the wall fire resistance rating is maintained, when drywall construction is used.
 13. Where sheet rock or drywall construction is used for front walls, it shall be of sufficient strength to maintain the doors in true lateral alignment. Drywall contractor to coordinate with elevator contractor.
 14. Before erection of rough walls and doors; erect hoistway sills, headers, and frames. After rough walls are finished; erect fascias and toe guards. Set sill level and slightly above finished floor at landings.

15. To maintain legal fire rating (masonry construction), door frames are to be anchored to walls and properly grouted in place.
16. The elevator wall shall interface with the hoistway entrance assembly and be in strict compliance with the elevator contractor's requirements.
17. General Contractor shall fill and grout around entrances, as required.
18. All walls and sill supports must be plumb where openings occur.
19. Locate a light fixture (200 lx / 19 fc) and convenience outlet in pit with switch located adjacent to the access door.
20. Provide telephone line, light fixture (200 lx / 19 fc), and convenience outlet in the hoistway at the landing where the elevator controller is located. Typically, this will be at the landing above the 1st floor. Final location must be coordinated with elevator contractor.
21. As indicated by elevator contractor, provide a light outlet for each elevator, in center of hoistway.
22. For signal systems and power operated door: provide ground and branch wiring circuits.
23. For car light and fan: provide a feeder and branch wiring circuits to elevator control cabinet.
24. Controller landing wall thickness must be a minimum of 8 1/2 inches thick. This is due to the controller being mounted on the second floor landing in the door frame on the return side of the door. For center opening doors, the controller is located on the right-hand frame (from inside the elevator cab looking out). These requirements must be coordinated between the general contractor and the elevator contractor.
25. Cutting, patching and recesses to accommodate hall button boxes, signal fixtures, etc.

1.02 SUBMITTALS:

- A. Product data: When requested, the elevator contractor will provide standard cab, entrance, and signal fixture data to describe product for approval.
- B. Shop drawings:
 1. Show equipment arrangement in the machine room/control space, pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.
 2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.
 3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.
 4. Indicate electrical power requirements and branch circuit protection device recommendations.

- C. Powder Coat Paint selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
 - D. Plastic laminate selection: Submit manufacturer's standard selection charts for exposed finishes and materials.
 - E. Metal Finishes: Upon request, standard metal samples provided.
 - F. Operation and maintenance data. Include the following:
 - 1. Owner's Manual and Wiring Diagrams.
 - 2. Parts list, with recommended parts inventory.
- 1.03 QUALITY ASSURANCE:
- A. Manufacturer Qualifications: An approved manufacturer with minimum fifteen years experience in manufacturing, installing, and servicing elevators of the type required for the project.
 - 1. Must be the manufacturer of the power unit, controller, signal fixtures, door operators cab, entrances, and all other major parts of the elevator operating equipment.
 - a. The major parts of the elevator equipment shall be manufactured in the United States, and not be an assembled system.
 - 2. The manufacturer shall have a documented, on-going quality assurance program.
 - 3. ISO-9001:2000 Manufacturer Certified
 - 4. ISO-14001:2004 Environmental Management System Certified
 - B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than fifteen years of satisfactory experience installing elevators equal in character and performance to the project elevators.
 - C. Regulatory Requirements:
 - 1. ASME/ANSI A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.
 - 2. International Building Code: (2012).
 - 3. NFPA 70 National Electrical Code.
 - 4. NFPA 80 Fire Doors and Windows.
 - 5. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
 - 6. Section 407 in ICC A117.1, when required by local authorities
 - D. Fire-rated Entrance Assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, UL10(B), and NFPA 80. Provide entrance assembly units bearing Class B or 1-1/2 hour label by a Nationally Recognized Testing Laboratory.
 - E. Inspection and testing:

1. Elevator Installer shall obtain and pay for all required inspections, tests, permits and fees for elevator installation.
2. Arrange for inspections and make required tests.
3. Deliver to the Owner upon completion and acceptance of elevator work.

1.04 DELIVERY, STORAGE AND HANDLING:

- A. Manufacturing will deliver elevator materials, components and equipment and the contractor is responsible to provide secure and safe storage on job site.

1.05 PROJECT CONDITIONS:

- A. Temporary Use: Elevators shall not be used for temporary service or for any other purpose during the construction period before Substantial Completion and acceptance by the purchaser unless agreed upon by Elevator Contractor and General Contractor with signed temporary agreement.

1.06 WARRANTY:

- A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 12 months from date of Substantial Completion.

1.07 MAINTENANCE:

- A. Furnish maintenance and call back service for a period of 3 months for each elevator after completion of installation or acceptance thereof by beneficial use, whichever is earlier, during normal working hours excluding callbacks.
 1. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation. Maintenance work, including emergency call back repair service, shall be performed by trained employees of the elevator contractor during regular working hours.
 2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.
 3. Manufacturer shall have a service office and full-time service personnel within a 100 mile radius of the project site.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS:

- A. Manufacturer: ThyssenKrupp Elevator's Endura Machine Room-Less hydraulic elevator (Basis of Design.
- B. Equal conforming products by one of the following are acceptable:
 1. Otis Elevator Co.

2. Schindler Elevator Corp.

- C. Section 01 60 00-Product Requirements: Product selection procedures: Substitutions: Not Permitted.

2.02 MATERIALS, GENERAL:

- A. All Elevator Cab materials including frame, buttons, lighting, wall and ceiling assembly, laminates and carpet shall have an EPD and an HPD, and shall meet the California Department of Public Health Standard Method V1.1–2010, CA Section 01350 as mentioned in 1.03.9 of this specification.
- B. Colors, patterns, and finishes: As selected by the Architect from manufacturer's standard colors, patterns, and finish charts.
- C. Steel:
1. Shapes and bars: Carbon.
 2. Sheet: Cold-rolled steel sheet, commercial quality, Class 1, matte finish.
 3. Finish: Factory-applied baked enamel.
- D. Plastic laminate: Decorative high-pressure type, complying with NEMA LD3, Type GP-50 General Purpose Grade, nominal 0.050" thickness. Laminate selection must be based on elevator manufacture's standard selections.
- E. Flooring: By others.

2.03 HOISTWAY EQUIPMENT:

- A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed. The car platform shall be designed and fabricated to support one-piece loads weighing up to 25% of the rated capacity.
- B. Sling: Steel stiles bolted or welded to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.
- C. Guide Rails: Steel, omega shaped, fastened to the building structure with steel brackets.
- D. Guide: Slide guides shall be mounted on top and bottom of the car.
- E. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on a steel template that is fastened to the pit floor or continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.
- F. Jack: Jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to insure adequate strength and freedom from leakage. Brittle material, such as gray cast iron, is prohibited in the jack construction. Provide the following jack type:
1. Twin post holeless telescopic 3-stage. Two jacks piped together, mounted one on each side of the car with each having three telescopic sections designed to extend in a synchronized manner when oil is pumped into the assembly.

2. Each jack section will be guided from within the casing or the plunger assembly used to house the section. Each plunger shall have a high-pressure sealing system which will not allow for seal movement or displacement during the course of operation.
 3. A follower guide shall be furnished for the top of the lower two plungers and be guided by rollers running inside a steel guide channel which is firmly attached to the guide rail system. This plunger guide system shall maintain a stabilized support for the plunger sections.
 4. Each jack assembly shall have check valves built into the assembly to allow for automatically re-syncing the three plunger sections by moving the jack to its fully contracted position.
- G. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the landings and correct for overtravel or under travel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.
- H. Wiring, Piping, and Oil: Provide all necessary hoistway wiring in accordance with the National Electrical Code. All necessary code compliant pipe and fittings shall be provided to connect the power unit to the jack unit. Provide proper grade oil as specified by the manufacturer of the power unit.
- I. Pit moisture/water sensor located approximately 1 foot above the pit floor to be provided. Once activated, elevator will perform "flooded pit operation", which will run the car up to the designated floor, cycle the doors and shut down and trip the circuit breaker shunt to remove 3-phase power from all equipment, including pit equipment.
- J. Motorized oil line shut-off valve shall be provided that can be remotely operated from the controller landing service panel. Also, a means for manual operation at the valve in the pit is required.
- 2.04 POWER UNIT:
- A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:
1. NEMA 4/Sealed Oil reservoir with tank cover including vapor removing tank breather
 2. An oil hydraulic pump.
 3. An electric motor.
 4. Electronic oil control valve with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and electro-magnetic controlling solenoids.
- B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.
- C. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating – motors shall be capable of 80 starts per hour with a 30% motor run time during each start.

- D. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.
1. Relief valve shall be adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.
 2. Up start and stop valve shall be adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.
 3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.
 4. Lowering valve and leveling valve shall be adjustable for down start speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling after slowdown is initiated.
 5. Provided with constant speed regulation in both up and down direction. Feature to compensate for load changes, oil temperature, and viscosity changes.
 6. Solid State Starting: Provide an electronic starter featuring adjustable starting currents.
 7. A secondary hydraulic power source (powered by 110VAC single phase) must be provided. This is required to be able to raise (reposition) the elevator in the event of a system component failure (i.e. pump motor, starter, etc.)
 8. Oil Type: Provide a zinc free, inherently biodegradable lubricant formulated with premium base stocks to provide outstanding protection for demanding hydraulic systems, especially those operating in environmentally sensitive areas.

2.05 HOISTWAY ENTRANCES:

- A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening bolted\knock down construction.
1. Manufacturer's standard entrance design consisting of hangers, doors, hanger supports, hanger covers, fascia plates (where required), sight guards, and necessary hardware.
 2. Main landing door & frame finish: ASTM A1008 steel panels, factory applied powder coat finish.
 3. Typical door & frame finish: ASTM A 366 steel panels, factory applied powder coat finish.
- B. Integrated Control System: the elevator controller to be mounted to hoistway entrance above 1st landing. The entrance at this level, shall be designed to accommodate the control system and provide a means of access to critical electrical components and troubleshooting features. See Section 2.09 Control System for additional requirements.
- C. At the controller landing, the hoistway entrance frame shall have space to accommodate and provide a lockable means of access (group 2 security) to a 3-phase circuit breaker. See Section 2.11 Miscellaneous Elevator Components for further details.

- D. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Provide door restriction devices as required by code.
 - E. Door Hanger and Tracks: Provide sheave type two-point suspension hangers and tracks for each hoistway horizontal sliding door.
 - 1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.
 - 2. Hangers: Provide an adjustable device beneath the track to limit the up-thrust of the doors during operation.
 - 3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.
 - F. Hoistway Sills: Extruded metal, with groove(s) in top surface. Provide mill finish on aluminum.
- 2.06 CAR ENCLOSURE:
- A. Car Enclosure:
 - 1. Walls: Cab type, a laminate wall design, durable wood core finished on both sides with high pressure plastic laminate.
 - 2. Reveals and frieze: Not applicable
 - 3. Canopy: Cold-rolled steel with hinged exit.
 - 4. Ceiling: Downlight type, metal pans with suspended LED downlights and dimmer switch. Number of downlights shall be dependent on platform size with a minimum of six. The metal pans shall be finished with a factory applied powder coat finish.
 - 5. Cab Fronts, Return, Transom, Soffit and Strike: Provide panels faced with No. 4 brushed stainless steel.
 - 6. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic sliding guides.
 - a. Door Finish: Stainless steel panels: No. 4 brushed finish.
 - b. Cab Sills: Extruded aluminum, mill finish.
 - 7. Handrail: Provide 1.5" diameter cylindrical metal on side and rear walls on front opening cars and side walls only on front and rear opening cars. Handrails shall have a stainless steel, No. 4 brushed finish.
 - 8. Ventilation: Manufacturer's standard exhaust fan, mounted on the car top.
 - 9. Protection pads and buttons: Not required
 - B. Car Top Inspection: Provide a car top inspection station with an "Auto-Inspection" switch, an "emergency stop" switch, and constant pressure "up and down" direction and safety buttons to make the normal operating devices inoperative. The station will give the inspector complete control of the elevator. The car top inspection station shall be mounted in the door operator assembly.

2.07 DOOR OPERATION:

- A. Door Operation: Provide a direct or alternating current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. The door control system shall be digital closed loop and the closed loop circuit shall give constant feedback on the position and velocity of the elevator door. The motor torque shall be constantly adjusted to maintain the correct door speed based on its position and load. All adjustments and setup shall be through the computer based service tool. Door movements shall follow a field programmable speed pattern with smooth acceleration and deceleration at the ends of travel. The mechanical door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. AC controlled units with oil checks, or other deviations are not acceptable.
1. No Un-Necessary Door Operation: The car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as a dispatch car.
 2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.
 3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel shall reverse and the door shall reopen to answer the other call.
 4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door closing is prevented for a field programmable time, a buzzer shall sound. When the obstruction is removed, the door shall begin to close at reduced speed. If the infra-red door protection system detects a person or object while closing on nudging, the doors shall stop and resume closing only after the obstruction has been removed.
 5. Door Reversal: If the doors are closing and the infra-red beam(s) is interrupted, the doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close.
 6. Door Open Watchdog: If the doors are opening, but do not fully open after a field adjustable time, the doors shall recycle closed then attempt to open six times to try and correct the fault.
 7. Door Close Watchdog: If the doors are closing, but do not fully close after a field adjustable time, the doors shall recycle open then attempt to close six times to try and correct the fault.
 8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.
- B. Door Protection Device: Provide a door protection system using microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen.

2.08 CAR OPERATING STATION:

- A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in an integral swing return panel requiring no applied faceplate. Wrap return shall have a No. 4 brushed stainless-steel finish. The main car operating panel shall be mounted in the return and comply with handicap requirements. Pushbuttons that illuminate using long lasting LED's shall be included for each floor served, and emergency buttons and switches shall be provided per code. Switches for car light and accessories shall be provided.
- B. Emergency Communications System: Integral phone system provided. Coordinate with Owner's VOIP phone system.
- C. Auxiliary Operating Panel: Not Required.
- D. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.
- E. Special Equipment: Limited Access Operation: Keyswitch and card reader space. (Card reader by others)

2.09 CONTROL SYSTEMS:

- A. Controller: Shall be integrated in a hoistway entrance jamb. Should be microprocessor based, software oriented and protected from environmental extremes and excessive vibrations in a NEMA 1 enclosure. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.
- B. Service Panel – to be located outside the hoistway in the controller entrance jamb and shall provide the following functionality/features:
 - 1. Access to main control board and CPU
 - 2. Main controller diagnostics
 - 3. Main controller fuses
 - 4. Universal Interface Tool (UIT)
 - 5. Remote valve adjustment
 - 6. Electronic motor starter adjustment and diagnostics
 - 7. Operation of pit motorized shut-off valve with LED feedback to the state of the valve in the pit
 - 8. Operation of auxiliary pump/motor (secondary hydraulic power source)
 - 9. Operation of electrical assisted manual lowering
 - 10. Provide male plug to supply 110VAC into the controller

11. Run/Stop button

- C. Automatic Light and Fan shut down: The control system shall evaluate the system activity and automatically turn off the cab lighting and ventilation fan during periods of inactivity. The settings shall be field programmable.
- D. Emergency Power Operation: Full automatic operation (Simplex 10-D4A) Upon loss of the normal power supply, building-supplied standby power is available to the elevator on the same wires as the normal power. Once the loss of normal power has been detected and standby power is available, the elevator is lowered to a pre-designated landing and will open the doors. After passengers have exited the elevator, the doors are closed. At this time, the elevator is automatically allowed to continue service using the building-supplied standby power.
- E. Special Operation: Not Applicable.

2.10 HALL STATIONS:

- A. Hall Stations, General: Buttons shall illuminate to indicate call has been registered at that floor for the indicated direction.
 - 1. Provide one pushbutton riser with faceplates having a No. 4 brushed stainless-steel finish.
 - 2. Phase 1 firefighter's service key switch, with instructions, shall be incorporated into the hall station at the designated level.
- A. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.
- B. Hall Position Indicator: Not Applicable
- C. Hall lanterns: Not Applicable
- D. Special Equipment: Not Applicable

2.11 MISCELLANEOUS ELEVATOR COMPONENTS:

- A. Oil Hydraulic Silencer: Install multiple oil hydraulic silencers (muffler device) at the power unit location. The silencers shall contain pulsation absorbing material inserted in a blowout proof housing.
- B. Lockable three phase circuit breaker with auxiliary contact with shunt trip capability to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb and should be sized according to the National Electrical Code.
- C. Lockable single phase 110V circuit breaker for cab light and fan to be provided. Circuit breaker to be located behind locked panel (Group 2 security access) at controller landing entrance jamb should be sized according to the National Electrical Code

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and/or control room, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

- A. Install elevator systems components and coordinate installation of hoistway wall construction.
 - 1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.
 - 2. Comply with the National Electrical Code for electrical work required during installation.
- B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.
- C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.
- D. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualification of welding operators.
- E. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.
- F. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation, or vibration.
- G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.
- H. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascia and toe guards after rough walls finished. Set sill units accurately aligned and slightly above finish floor at landings.
- I. Lubricate operating parts of system where recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

- A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

- B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.
- 3.04 ADJUSTING
- A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.
- 3.05 CLEANING
- A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided. Stainless steel shall be cleaned with soap and water and dried with a non-abrasive surface; shall not be cleaned with bleached-based cleansers.
 - B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.
 - 1. Use environmentally preferable and low VOC emitting cleaners for each application type. Cleaners that contain solvents, pine and/or citrus oils are not permitted.
- 3.06 PROTECTION
- A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.
- 3.07 DEMONSTRATION
- A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.
 - B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that control systems and operating devices are functioning properly.
- 3.08 ELEVATOR SCHEDULE
- A. Elevator Quantity: 1
 - 1. Elevator Model: enduraMRL Above-Ground (3-Stage)
 - 2. Elevator Type: Hydraulic Machine Room-Less, Passenger
 - 3. Rated Capacity: 2500 lbs.
 - 4. Rated Speed: 100 ft./min.
 - 5. Operation System: TAC32H
 - 6. Travel: +/- 14'-8"

- 7. Landings: 2 total
- 8. Openings:
 - a. Front: 2
 - b. Rear: 0
- 9. Clear Car Inside: 6' - 8" wide x 5'-5' deep
- 10. Cab Height: 8'-0" standard
- 11. Hoistway Entrance Size: 3' - 6" wide x 7'-0" high
- 12. Door Type: Center Opening
- 13. Power Characteristics: 460 volts, 3 Phase, 60 Hz.
- 14. Seismic Requirements: Zone 2
- 15. Hoistway Dimensions: 8' - 8" wide x 6' - 8 3/4" deep
- 16. Pit Depth: 4' - 0"
- 17. Button & Fixture Style: Traditional Signal Fixtures
- 18. Special Operations: None

END OF SECTION

SECTION 22 00 10
PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installing plumbing piping, fittings, valves, hydrants, insulation, and appurtenances for:
 - a. Drain, waste, vent (DWV)
 - 1) Above ground, waste, and vent piping within buildings including vent stacks, horizontal branches, traps, and connections to fixtures and drains.
 - 2) Underground building drain piping including mains, branches, traps, connections to fixtures and drains, and connections to stacks terminating at connection to sanitary sewers 10 ft outside inner face of foundation wall.
 - b. Hot/cold domestic water piping.
 - c. Specialty systems, as shown on drawings or specified.

B. Related Activities: pipe installation, testing, sterilization, and coordination with fixtures and equipment

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications:

1. Section 22 05 29 – Hangers and Supports
2. Section 22 40 00 – Plumbing Fixtures
3. Section 31 23 33 – Trenching and Backfilling Utilities

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM B88 - Standard Specification for Seamless Copper Water Tube
2. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40 and 80 Manufacturers Standardization Society
3. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

4. ASTM F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
 5. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core
 6. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings
 7. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- B. American National Standards Institute (ANSI)
1. NSI A112.5.1 - Standard for Cast Iron Soil Pipe and Fittings.
- C. Cast Iron Soil Pipe Institute (CISPI)
1. ISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- D. International Code Council (ICC)
1. International Plumbing Code (IPC), Latest Edition
 2. Georgia Amendments to IPC
- E. Manufacturers Standardization Society (MSS)
1. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends
 2. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves
- F. National Sanitation Foundation (NSF)
1. NSF/ANSI 61 - Drinking Water System Components
- 1.04 SUBMITTALS
- A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
- B. Product Data:
1. Submit manufacturer's data for piping, fittings, valves, hydrants, insulation, and heat tracing, including material specifications, pressure ratings, and NSF/ANSI 61 compliance for potable water systems.
- C. Shop Drawings:
1. Provide piping layouts, valve schedules, hydrant locations, and connection details to fixtures and equipment.
- D. Test Reports
1. Submit results of hydrostatic, air, and sterilization tests.

1.05 QUALITY ASSURANCE:

- A. Installer: Licensed plumber with 5 years' experience in plumbing systems per IPC.
- B. Regulatory Requirements:
 - 1. Comply with IPC, latest editions, and Georgia amendments as minimum standards.
 - 2. Where drawings and specifications exceed code, follow drawings/specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Ship piping and fittings in protective packaging, labeled with size, material, and standard.
- B. Storage: Store pipe, fittings, and appurtenances off the ground. Protect from damage and UV exposure.

PART 2 - PRODUCTS

2.01 DRAIN, WASTE, AND VENT (DWV) PIPING

- A. The following types of pipe and fittings shall be used for drain, waste, and vent piping.
 - 1. PVC Pipe and Fittings
 - a. Location: All above and below grade DWV Piping unless otherwise scheduled or noted on the drawings.
 - b. Standard: ASTM D1785 (Schedule 40) and ASTM D2665 (DWV), solid core
 - c. Fittings: Solvent-weld, matching pipe schedule, per ASTM D2665
 - d. Solvent Cement: ASTM D2564, compatible with PVC; Primer: ASTM F656
 - 2. Cast Iron Pipe and Fittings.
 - a. Location: Where scheduled or noted on the drawings, for Drain, Waste and Vent (DWV) Piping.
 - b. Hub and Spigot Cast Iron Soil Pipe (CISP) and Fittings:
 - 1) Use in below slab or buried locations.
 - 2) Conform to ASTM A74, Service Weight
 - 3) Pipe and Fittings shall be tar coated inside and out.
 - 4) Compression gaskets shall meet the requirements of ASTM C 564
 - c. No Hub Cast Iron Soil Pipe and Fittings:
 - 1) Use in above slab locations

- 2) Conform to Cast Iron Soil Pipe Institute, Standard 301 and ASTM A888.
- 3) Heavy duty couplings shall conform to ASTM C1540 consisting of elastomeric compound gasket (ASTM C 564) housed inside a 304 stainless steel corrugated shield with stainless steel clamps and screws.
- 4) Pipe and Fittings shall be tar coated inside and out except where exposed. For exposed locations, tar coat on the inside only.

2.02 WATER PIPING (HOT AND COLD)

A. The following types of pipe and fittings shall be used for domestic water piping.

1. Copper Pipe and Fittings:

- a. Location: All above grade water piping unless noted otherwise scheduled or noted on the drawings.
- b. Pipe: ASTM B88, Type K
- c. Fittings: Wrought copper, solder joint, per ASTM B16.22
- d. Solder: Lead-free, 95/5 tin-antimony, NSF/ANSI 61-compliant for potable water

2. PVC (CPVC) Pipe and Fittings:

- a. Location: Where scheduled or indicated on the drawings for domestic hot and cold water piping systems.
- b. Pipe: ASTM F441, Schedule 80 (hot water) or ASTM D1785, Schedule 80 (cold water), where shown on drawings.
- c. Fittings: Solvent-weld, matching pipe schedule, per ASTM F438/F439
- d. Solvent Cement: ASTM F493, compatible with CPVC; Primer: ASTM F656

2.03 ACID RESISTING (AR) PIPE AND FITTINGS

A. Location: Waste from lab sinks and traps unless otherwise scheduled or noted on the drawings.

B. Pipe: SCH 40 Polypropylene, per ASTM D4101

1. Above Slab: Blue-line flame retardant
2. Below Slab: Brown-line Non-Flame Retardant

C. Joints: Joints shall be of the following types as recommended by the manufacturer

1. Mechanical "Riontite" type, with two Type 316 stainless steel inner rings, 5/16-inch bolts, and rigid low-carbon steel outer clamp.
2. Coil fusion

D. Fittings: Matching polypropylene, mechanical, per ASTM D4101

- E. Floor Drains: Acid-resistant, matching piping material, with corrosion-resistant strainers
- F. Manufacturers: Orion, Labline by IPEX, Fuseal by GF Piping, or equal

2.04 VALVES AND ACCESSORIES

A. Gate, Globe, and Angle Valves

- 1. Location: Domestic water lines or where otherwise noted
- 2. Standard: MSS SP-80, bronze, 175 psi working pressure for <3-inch
- 3. Features:
 - a. Operating wheels, stuffing boxes, packing glands, and means for packing while open and under pressure
 - b. Handwheel operators and screwed bonnet.
 - c. Gate valves shall be of solid wedge type, double seat, rising stem (cold water) and non-rising stem (hot water)
- 4. Manufacturers: Crane, NIBCO, Milwaukee, or equal

B. Ball Valves

- 1. Location: Where scheduled or noted on drawings
- 2. Standard: MSS SP-110, full-port, two-piece or three-piece construction
 - a. Body and Ball: Cast bronze per ASTM B584 or ASTM B62, lead-free (<0.25% lead per NSF/ANSI 372)
 - b. Stem: Dezincification-resistant brass or stainless steel, blowout-proof design
 - c. Seats and Seals: PTFE (Teflon), rated for 250°F minimum
- 3. Manufacturers: NIBCO T-585-70, Apollo Valves (Conbraco) Series 77CLF-A, or equal

C. Needle Valves

- 1. Location: Compressed air, gas, or vacuum lines, where shown
- 2. Standard: MSS SP-80, bronze, 125 psi steam working pressure, integral seat
- 3. Manufacturers: Stockham, Walworth, or equal

D. Check Valves

- 1. Location: Where scheduled or noted on drawings
- 2. Standard: MSS SP-80, Type 3 (swing check) or Type 4 (horizontal lift check), as scheduled
 - a. Body: Cast bronze per ASTM B584 or ASTM B62, lead-free (<0.25% lead per NSF/ANSI 372).

- b. Disc or Swing: Bronze or PTFE, designed for tight sealing
- c. Hinge Pin: Stainless steel or brass, corrosion-resistant
- 3. Manufacturers: NIBCO T-413-Y-LF, Crane Valve D-137-LF, or equal

E. Water Pressure Reducing Valves

- 1. Location: Provide pressure reducing valve on supply line to each building unless noted otherwise on the drawings.
- 2. Standard: Low lead cast bronze body (ASTM B584) with integral bypass check valve.
- 3. Max. working pressure: 300 psi
- 4. Manufacturers: Zurn 500XL, Apollo, or equal.

2.05 FIXTURE CONNECTIONS

A. Stop Valves

- 1. Location: Provide on all fixture supply lines
- 2. Type: Quarter turn angle stop, forged, lead free brass body with high temperature and corrosion resistant O-rings, rated for 125 psi minimum.
- 3. End Connections: Threaded inlet, with 3/8" threaded outlet
- 4. Manufacturers: CopperFit MiiFlex, BrassCraft or equal

B. Flexible Hoses:

- 1. Location: Provide on all fixture supply lines
- 2. Type: Flexible EPM or PEX inner tube with stainless steel exterior braiding., rated for 125 psi minimum.
- 3. Manufacturers: BrassCraft, Fluidmaster, or equal

2.06 HYDRANTS

A. Hose Bibs

- 1. Type: 3/4-inch, non-freeze, brass casing, T-handle, NSF/ANSI 61-compliant
- 2. Accessories: One quick-connect female hose fitting per bib
- 3. Manufacturers: Woodford, Zurn, or equal

B. Post Hydrants

- 1. Type: 2-foot, non-freeze, self-draining, 1.5-inch NST outlet, brass or aluminum internals.
- 2. Operation: 9/16-inch square nut, counterclockwise to open, clockwise to close. Hydrant must seal the drain outlet in all positions from 1/4-open to fully-open

3. Features: Serviceable above ground, standard O-rings/valve seals
4. Manufacturers: Kupferle Foundry Model TF200, Simmons, or equal

C. Wall Hydrants

1. Type: Cast brass, non-freeze, 1-inch NPT outlet, T-handle, polished face, nylon seat
2. Manufacturers: Josam 71000-8, Zurn W8600L6+2, or equal

D. Yard Hydrants:

1. Type: 1-inch, non-freeze, galvanized casing, 3/4-inch inlet/outlet, vacuum breaker, siphon drain.
2. Manufacturers: Josam 71400, Zurn 8610, or equal

2.07 BACKFLOW PREVENTERS

A. Reduced Pressure Zone (RPZ)

1. Location: Where scheduled or indicated on the drawings.
2. Standard: ASSE 1013, AWWA C511, USC FCCCHR-approved

B. Body: Cast bronze per ASTM B584, lead-free (<0.25% lead per NSF/ANSI 372), or stainless steel for larger sizes (>2-inch)

- a. Check Valves: Bronze or stainless steel, with resilient seats (e.g., EPDM or silicone)
- b. Relief Valve: Bronze or stainless steel, with corrosion-resistant diaphragm
- c. Springs and Fasteners: Stainless steel, Type 304 or 316, corrosion-resistant.
2. Size: As shown on the drawings
3. Pressure Rating: 175 psi working pressure, non-shock, suitable for 33°F to 140°F water temperature
4. End Connections: Threaded (ANSI B1.20.1 NPT) for ≤ 2 -inch and Flanged (ANSI B16.1 Class 125)
5. Configuration: Two independent check valves with intermediate relief valve, four test cocks, and two isolation valves) for >2-inch
6. Flow Loss: Maximum 12 psi at rated flow, per ASSE 1013 performance data
7. Features:
 - a. NSF/ANSI 61-certified for potable water systems
 - b. Modular check valve design for field repair without removal
 - c. Test cocks with threaded caps, accessible for annual testing

8. Accessories:

- a. Isolation Valves: Bronze ball valves (1/2-inch to 2-inch) or gate valves (>2-inch), installed upstream and downstream of RPZ, lead-free, NSF/ANSI 61-compliant.
- b. Strainer: Y-type, bronze or stainless steel, same size as RPZ, installed upstream to protect check valves, with 20-mesh screen, NSF/ANSI 61-compliant
- c. Enclosure (Exterior): Aluminum or fiberglass, lockable, with freeze protection (insulation and heater) for exterior RPZ assemblies, sized per manufacturer's clearance requirements, WattsBox, Hubbell Hot Box, or equal.

2.08 CLEANOUTS.

A. Exterior:

1. Cast iron ferrule, heavy brass/bronze countersunk plug
2. Set in 18x18x8-inch concrete pad, flush with grade
3. Manufacturers: Josam 58500, Zurn Z1470, or equal

B. Concealed Floor/Ceiling:

1. Coated cast iron, ABS tapered plug, with bronze, nickel bronze, or Nikaloy adjustable top
2. Manufacturers: Zurn Z-1400, Josam 55000, Jay R. Smith 4020, or equal

C. Wall:

1. Tapped for screws, stainless steel access cover
2. Manufacturers: Josam 58600, Jay R Smith 4420, or equal

2.09 FLOOR, SHOWER, AND AREA DRAINS

A. Floor and Shower Drains

1. Coated cast iron body with bottom outlet
2. 9" adjustable strainer (unless noted otherwise), Bronze, nickel bronze, or Nikaloy as preferred by the Owner.
3. Provide with primer taps where noted on the drawings.
4. Manufacturers: Zurn Z415N, Josam 3000 A, or equal

B. Floor Drains (Equipment Areas)

1. Coated cast iron bottom with bottom outlet, sediment bucket, inside caulking , and
2. 9" cast iron grate.
3. Provide with primer taps where noted on the drawings.

4. Manufacturers: Josam 32100, Zurn Z550, or equal

C. Trap Seals and Primer Valves

1. Trap Seals: Unless noted otherwise, all floor drains shall be equipped with trap seals, SureSeal by as manufactured by Rectorseal or equal.
2. Trap Water Seal: Where indicated on the drawings, provide a trap connection for maintaining trap water seal.
 - a. Connection shall consist of a trap primer valve with removable operating parts, integral vacuum breaker, and gasketed access cover, installed in the cold water service line to plumbing fixture.
 - b. Primer valve shall be Josam #88250, Watts #200, or Jay R. Smith #2699

2.10 PLUMBING ACCESSORIES

- A. Escutheons: Chrome-plated brass/stainless, for all exposed penetrations, ensuring aesthetic finish.

2.11 WATER PIPE INSULATION

A. Location:

1. Hot Water Piping: Provide insulation on all hot water piping
2. Cold Water Piping: Provide insulation on all cold water piping located in semi-conditioned areas such as above the suspended ceiling

B. Type: Closed Cell elastomeric foam products rated for service. Conductivity must not exceed 0.27 Btu per inch/h-ft²-F°

C. Thickness: ½" minimum. (Recirculating hot water systems shall have 1" minimum.)

D. Manufacturers: Armacell Armaflex AP, Nomaco FlexTherm, or equal.

2.12 PIPE HANGERS AND SUPPORTS

- A. Refer to Section 22 05 29, Hangers and Supports

PART 3 - EXECUTION

3.01 GENERAL

- A. Drawings are intended to be diagrammatic and do not include all offset, fittings, and specialties required. Drawings may not include any location dimensions and should not be scaled for installation purposes. All dimensional information required for installation must be collected from actual field conditions.
- B. Before construction begins, check locations and inverts of existing and proposed pipes, sewer, and mains.
- C. Report to Engineer any conflicts or unsatisfactory conditions before start of construction.

- D. Follow the general layout shown on the drawings in all cases except where other work may interfere, use minimum number of fittings.
- E. Lay out pipes to fall within partitions, walls, or ceilings, and to not require furring other than as shown on the drawings.

3.02 DRAIN, WASTE, AND VENT (DWV)

A. Installation

1. Install drain pipe with minimum 1/4-inch per foot slope (2%), or 1/8-inch for >3-inch pipes, per IPC.
2. Horizontal vent runs shall be installed straight, without sagging, and sloped to provide drainage to connected drain pipe.
3. Solvent-weld PVC per ASTM D2564; secure hubless cast iron couplings per CISPI 310.
4. Extend vents 12 inches above roof, flashed per roofing manufacturer
5. Install cleanouts per IPC at branch ends, 45-degree changes, and 100-ft intervals
6. All changes in direction of DWV piping shall be made using only sanitary drainage pattern fittings.
7. Support piping as required, refer to Section 22 05 29, Hangers and Supports
8. Encase below-slab piping in 6-inch Class B concrete

B. Testing

1. Test the entire drainage and sanitary system as directed by local codes.
2. Plug all necessary opening appended to the system.
3. Fill the system or section thereof with water to the level of the top of highest vent stack.
4. Not less than 10 feet of water pressure should be maintained for one hour, unless otherwise required.
5. Contractor shall provide all additional equipment, piping, fittings, and appurtenances required for the testing.
6. Should any test disclose excessive leakage, locate and repair as required until pipe is accepted.

3.03 DOMESTIC WATER PIPING

A. Installation

1. Thoroughly clean all items before installation. Cap pipe openings to exclude dirt until fixtures are installed or final connections are made.
2. Install water lines with 1/2-inch per 10 ft pitch for drainage

3. Solder copper joints with lead-free solder (ASTM B828); solvent-weld PVC/CPVC per ASTM F493
4. Provide shutoff valves (ball or gate) at branch connections and shutoff points.
5. Provide unions and shutoff valves suitably located to facilitate maintenance and removal of equipment and appurtenances.
6. Provide sufficient swing joints, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the Drawings.
7. Provide complete dielectric isolation between ferrous and non-ferrous metals.
8. Support piping as required, refer to Section 22 05 29, Hangers and Supports
9. Install pipe insulation on hot and cold water lines where specified in the Products Section or where otherwise noted on the Drawings.
10. Show no tool marks on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during connection.
11. Provide escutcheons on all pipes exposed to view where passing through walls, floors, partitions, ceilings, and similar locations.
12. Encase below-slab piping in 6-inch Class B concrete

B. Testing

1. Hydrostatic pressure test at 150 psi for 1 hour. Pressure shall be based on the elevation of the lowest point of the section under test and corrected to the elevation of the pressure gauge.
2. Conduct pressure test prior to connection of fixtures.
3. Contractor shall provide all additional fitting, pressure gauges, and appurtenances necessary to conduct pressure test.

C. Disinfection

1. New potable water systems shall be disinfected in accordance with the International Plumbing Code and AWWA.
2. The pipe shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.
3. The system or part thereof shall be filled with water/chlorine solution containing not less than 50 ppm of chlorine and allowed to stand for 24 hours. A minimum residual of 10 ppm chlorine shall remain at the end of the 24-hour period.
4. Flush line thoroughly after testing.

3.04 BACKFLOW PREVENTERS

A. Installation

1. Install RPZ assemblies per manufacturer's instructions, IPC, State rules, and drawings, in accessible locations.
2. Orient horizontally (unless vertical approved by manufacturer), with relief valve discharge downward, minimum 12-inch above floor/grade to prevent submersion.
3. Provide isolation valves (ball/gate) upstream and downstream for maintenance.
4. For exterior locations, install in lockable, insulated enclosure with heater for freeze protection., set on 6" concrete pad, sloped for drainage, with enclosure anchored per manufacturer.

B. Testing

1. Conduct ASSE 1013 field test by certified backflow prevention tester after installation, in presence of Owner or Engineer's designated inspector.
2. Test Parameters: Verify first check valve closure (minimum 5 psi differential), second check valve closure (minimum 1 psi differential), relief valve opening (2 psi below first check), and no backflow under backpressure or backsiphonage.
3. Method: Use differential pressure gauge and test kit per USC FCCCHR Manual of Cross-Connection Control, 10th Edition, with three-valve or five-valve setup.
4. Duration: Complete test within 30 minutes per device, with no leakage or pressure loss.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installing plumbing fixtures as scheduled or shown on the Drawings.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications:

1. Section 22 00 10 – Plumbing Systems
2. Section 22 05 29 – Hangers and Supports
3. Section 10 28 00 – Toilet and Bath Accessories

1.03 REFERENCES

A. American Society of Mechanical Engineers (ASME)

1. ASME A112.18.1 - Plumbing Supply Fittings
2. ASME A112.19.2 - Ceramic Plumbing Fixtures
3. ASME A112.19.3 - Stainless Steel Plumbing Fixtures

B. American Society for Testing and Materials (ASTM):

1. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel

C. International Code Council (ICC)

1. International Plumbing Code (IPC), Latest Edition
2. Georgia Amendments to IPC

D. US Department of Justice

1. ADA Standards for Accessible Design

E. National Sanitation Foundation (NSF)

1. NSF/ANSI 61 - Drinking Water System Components

2. NSF/ANSI 372 - Drinking Water System Components - Lead Content

F. Underwriters Laboratories (UL)

1. UL 1951 - Standard for Safety for Plumbing Accessories

1.04 SUBMITTALS

A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.

B. Product Data:

1. Submit manufacturer's data for fixtures, fittings, and accessories

C. Shop Drawings:

1. Provide layouts showing fixture locations, ADA clearances, fitting connections, and coordination with piping and finishes.

D. Maintenance Data

1. Include maintenance manuals for faucets, flush valves, water heaters, and expansion tanks, and other similar equipment with cleaning instructions and replacement part numbers.

1.05 QUALITY ASSURANCE:

A. Installer: Licensed plumber with 5 years' experience in plumbing systems per IPC.

B. Regulatory Requirements:

1. Comply with IPC, latest editions, and Georgia amendments as minimum standards.

2. Where drawings and specifications exceed code, follow drawings/specifications.

3. Fixtures and fittings shall be lead-free per NSF/ANSI 372 (<0.25% lead) and NSF/ANSI 61-certified for potable water.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Ship fixtures and fittings in protective packaging, labeled with type, size, and standard

B. Storage: Store indoors, in dry conditions, with caps on valves, faucets, and traps to prevent contamination or thread damage; keep water heaters and expansion tanks upright

PART 2 - PRODUCTS

2.01 ADA-COMPLIANT TRANSFER SHOWER

A. Shower Stall:

1. Material: Fiberglass-reinforced plastic (FRP) or acrylic, white, slip-resistant floor per ICC A117.1

2. Standard: ASME A112.19.2, 2010 ADA Standards (Section 608)
3. Size: 36-inch x 36-inch, with 1/2-inch max threshold in accordance with ADA Section 303 (Changes in Level)
4. Drain: 2-inch minimum, center or offset, with stainless steel strainer
5. Features
 - a. Folding seat, 250 lb capacity, ADA compliant
 - b. ADA compliant grab bars:
 - c. Slip resistant floor, coefficient of friction ≥ 0.6
6. Controls
 - a. Shower Valve: Pressure-balance, single-handle, brass, lead-free, 2.5 gpm at 80 psi, per ASME A112.18.1, with adjustable temperature limit stop, unless otherwise scheduled on the Drawings.
 - b. Showerhead: Hand-held, adjustable spray, 2.5 gpm max., with 60-inch stainless steel hose, mounted on 24" min. slide bar, per ADA 608.5
7. Accessories
 - a. Provide ADA compliant vinyl collapsible dam to prevent excessive escape of water.
 - b. Provide weight vinyl shower curtain.

2.02 TANKED TOILETS

- A. Location: Provide tanked toilets where scheduled or indicated on the drawings as follows:
- B. Material: Vitreous china, white, elongated bowl, per ASME A112.19.2
- C. Flush Rate: 1.28 gpf maximum
- D. Configuration: Floor-mounted, siphon jet
- E. Toilet Seat: Elongated, open-front, plastic or phenolic, white, with no cover
- F. Manufactures: American Standard, Kohler or Equal
- G. Types
 1. ADA Compliant Toilets:
 - a. Location: Provide ADA toilets where scheduled or indicated on the drawings. ADA compliant toilets shall be provided in all single user restrooms unless noted otherwise on the drawings.
 - b. Height: 17-19" from floor to top of seat per ADA 604.4
 - c. Flush controls shall be provided on the open side of the tank per ADA 604.9.5

- d. Toilet placement, clearance, grab bars, and accessories shall be provided and installed per ADA guidelines or detailed on the drawings.

2. Standard Toilets

- a. Location: Provide standard height toilets where scheduled or indicated on the drawings. *ADA compliant toilets shall be provided in all single user restrooms unless noted otherwise on the drawings.*
- b. Height: 15-16" from floor to top of seat per ADA 604.4

2.03 TANKLESS TOILETS WITH FLUSH VALVES

- A. Location: Provide tankless toilets where scheduled or indicated on the drawings as follows:
- B. Material: Vitreous china, white, elongated bowl, per ASME A112.19.2
- C. Configuration: Floor-mounted, siphon jet (unless otherwise scheduled)
- D. Flush Valve: Manual, diaphragm or piston type, cast brass body with chrome finish, 1.28 gpf max., lead-free, 1" angles stop and vandal resistant cap, high pressure vacuum breaker with down tube, left or right installation, ADA compliant non-hold open handle, as manufactured by American Standard, Sloan, or equal
- E. Water Supply Size: Supply line to toilets with flush valves shall not be less than 1.25" unless otherwise allowed by the manufacturer.
- F. Toilet Seat: Elongated, open-front, plastic or phenolic, white, with no cover
- G. Manufactures: American Standard, Kohler or Equal
- H. Types

1. ADA Compliant Toilets:

- a. Location: Provide ADA toilets where scheduled or indicated on the drawings. *ADA compliant toilets shall be provided in all single user restrooms unless noted otherwise on the drawings.*
- b. Height: 17-19" from floor to top of seat per ADA 604.4
- c. Flush controls shall be provided on the open side of the tank per ADA 604.9.5
- d. Toilet placement, clearance, grab bars, and accessories shall be provided and installed per ADA guidelines or detailed on the drawings.

2. Standard Toilets

- a. Location: Provide standard height toilets where scheduled or indicated on the drawings. *ADA compliant toilets shall be provided in all single user restrooms unless noted otherwise on the drawings.*
- b. Height: 15-16" from floor to top of seat per ADA 604.4

I. Accessories:

1. Mounting Kit: Toilet mounting kit including floor flange, reinforced wax ring, EPDM or neoprene gaskets
2. Mounting and assembly hardware: stainless steel

2.04 URINAL

- A. Location: Provide urinals where scheduled or indicated on the drawings. Where urinals are scheduled or indicated on the drawings, at least one ADA accessible urinal must be provided unless noted otherwise.
- B. Type: Wall hung
- C. Material: Vitreous china, white
- D. Configuration: Siphon jet, 2-inch outlet
- E. Depth: 13.5" minimum measured from the outer face of the urinal to the back of the fixture.
- F. Rim Height:
 1. ADA Installation: 17" max.
 2. Non-ADA Installation: 24" max.
- G. Flush Valve: Manual, diaphragm or piston type, cast brass body with chrome finish, 0.5 gpf max., lead-free, angle stop and vandal resistant cap, high pressure vacuum breaker with down tube, left or right installation, ADA compliant non-hold open handle, as manufactured by American Standard, Sloan, or equal.
- H. Carrier: Wall-mounted, cast iron, adjustable, 500 lb capacity, per ASME A112.6.1
- I. Manufacturers: American Standard, Kohler or Equal

2.05 BATHROOM LAVATORY

- A. Location: Provide lavatories where scheduled or indicated on the drawings. A minimum of one ADA accessible lavatory must be provided per restroom unless noted otherwise.
- B. Fixture
 1. Material: Vitreous china, white, rectangular or oval as shown on the drawings
 2. Type: Wall hung or countertop -mounted as scheduled or shown on the drawings.
 3. Size: 20" x 18" minimum unless otherwise scheduled or noted on the drawings.
 4. Features: Overflow, smooth glaze for hygiene
 5. Mounting Height:
 - a. ADA Installation: 34" max. to rim with 27" min. knee space.
 - b. Standard Installation: 34-36", match counter height.

C. Manufacturers: American Standard, Zurn, or equal

D. Accessories:

1. Faucet: Unless less otherwise scheduled, provide dual handle (ADA compliant blades), centerset faucet with gooseneck spout, cast brass construction with all brass shank nuts and coupling nuts, 1.5 gpm, pressure compensating aerator, 1/4 turn washerless ceramic disc valve cartridges as manufactured by American Standard, Moen, or equal
2. Pop-up drain assembly
3. P-trap assembly: Cast body, chrome plated with cleanout
4. Carrier (wall hung units): Cast iron, adjustable, 250 lb minimum capacity

2.06 WATER HEATER

A. Location: Provide where scheduled or indicated on the drawings with all applicable accessories

B. Type: Commercial, electric, tanked

C. Standard: UL 174 (Household Electric Storage Tank Water Heaters), Energy Star-certified. Models shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IES 90.1

D. Capacity: Provide 50 gallon unless otherwise scheduled or indicated on the drawings, suitable for commercial demand.

E. Power: 240V, 4500W, single phase unless otherwise scheduled or indicated on the drawings. Contractor to verify electrical requirements match the voltage and phase of panel in which the unit is supplied.

F. Features:

1. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod.
2. All internal surfaces of the heater(s) exposed to water shall be glasslined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 1400°F to 1600°F.
3. Electric heating elements shall be medium watt density with zinc plated copper sheath.
4. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch.
5. The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation.
6. Electrical junction box with heavy duty terminal block shall be provided (except on 120V & 277V).
7. The drain valve shall be located in the front for ease of servicing.

8. Heater tank shall have a three year limited warranty

G. Manufacturers: AO Smith DEL, Bradford White, or equal

H. Accessories:

1. Thermal Expansion Tank

- a. Requirement: A thermal expansion tank is required where a storage water heater is supplied with cold water that passes through a check valve, pressure reducing valve or backflow preventer per IPC 607.3.
- b. Location: Connect to the water heater cold water supply pipe at a point that is downstream of all check valves, pressure reducing valves and backflow preventers.
- c. Type: Diaphragm, pre-pressurized, steel shell, potable water-rated
- d. Capacity: 2 gallon minimum. Thermal expansion tanks shall be sized in accordance with the tank manufacturer's instructions and shall be sized such that the pressure in the water distribution system shall not exceed 80 psi as required by IPC Section 604.8.
- e. Features: Butyl rubber diaphragm, stainless steel connection, corrosion-resistant coating
- f. Manufacturers: Amtrol Therm-X-Trol, Watts, or equal
- g. Accessories
 - 1) Bronze, full-port, ball (shut-off) valve
 - 2) Provide vibration resistant mounting bracket or floor stand as recommended by the manufacturer.

2. Pan

- a. Provide aluminum or plastic drainable pan for each water heater.
- b. The pan shall not be less than 1.5" in depth and shall be of sufficient size and shape to receive all dripping or condensate from the tank or water heater.
- c. The pan shall be drained by indirect waste pipe having a diameter of not less than ¾". The drain shall extend full size and terminate over a suitably located indirect waste receptor or floor drain or extend to the exterior of the building and terminate not less than 6" and not more than 24" above the ground surface.

2.07 LABORATORY SINKS

A. Refer to Section 12 35 33, Laboratory Casework and Accessories

2.08 KITCHEN / BREAKROOM SINK

A. Location: Provide kitchen or breakroom sinks where scheduled or indicated on the drawings.

B. Fixture:

1. Type: Equal double bowl, drop-in, top mounted, unless otherwise scheduled or indicated on the drawings.
2. Material: Min. 20 gauge, 304 stainless steel with lustrous satin finish
3. Sound Deadening: Sides and bottom pads
4. Size: As scheduled or noted on the drawings
5. Manufacturers: American Standard, Elkay, or equal

C. Faucet and Handspray:

1. Type: Two handled kitchen faucet with separate handspray, 2.2 gpm, ADA compliant
2. Construction: Brass body with all brass inlet shanks and coupling nuts
3. Valve Unit: 1/4 turn, washerless, ceramic disc valve cartridges that are reversible for use on either hot or cold side.
4. Spout: 7-9" brass gooseneck swivel spout
5. Finish: Stainless Steel
6. Manufacturer: American Standard, Kohler or equal

D. Accessories:

1. Stainless-steel sink drain strainer and pop-up sink stopper for each bowl.
2. P-trap assembly: Cast body, chrome plated with cleanout

2.09 DISHWASHER

- A. Location: Provide dishwasher/bottle washers where scheduled or indicated on the drawings.
- B. Fixture
 1. Provide model or equal as scheduled on the drawings.

2.10 SAFETY SHOWERS AND EYEWASH STATIONS

A. Interior Combination Shower and Eyewash

1. Location: Provide where scheduled or indicated on the drawings
 - a. Install stations within 10 seconds, approximately 55', of hazard, on the same level as hazard and with unobstructed travel path.
 - b. Clearance: There shall be no barrier within a 16" radius of center point of shower head or within 6" of the eye/face wash
2. Fixture: Combination eyewash/shower safety station with ABS plastic shower head, internal 20 GPM flow control, stainless steel eyewash bowl, powder-coated cast aluminum flag handle and floor flange, 1 1/4" IPS Schedule 40 galvanized pipe and fittings, 1" IPS and 1/2"

IPS U.S. made chrome-plated brass stay-open ball valves, and polished stainless steel pull rod. Unit shall have (2) polypropylene GS-Plus™ spray heads with integral “flip-top” dust covers, filters, and 1.6 GPM flow control orifices mounted on a chrome-plated brass eyewash assembly.

3. Performance: Unit shall meet or exceed ANSI Z358.1 – 2014 with a full 2-year warranty.
4. Manufacturer: Guardian G1902 or equal
5. Accessories:
 - a. Thermostatic Mixing Valve
 - 1) Construction. Brass valve shall be furnished with lockable shutoff valves on the hot and cold water supplies, internal check valves to prevent cross-mixing of hot and cold water and stainless steel basket filters to remove debris from the water flow. Valve shall be furnished with outlet temperature gauge and stainless steel mounting bracket. Valve shall meet the requirements of the U.S. Safe Drinking Water Act as lead-free.
 - 2) Inlets/Outlet. Valve shall have 1” NPT female inlets and 1-1/4” NPT outlet. Inlets can be positioned in the field for top, back or bottom supply. Outlet can be positioned on top or bottom.
 - 3) Temperature Control. Valve shall have a precision thermal actuator to accurately blend hot and cold water. Valve is factory preset to deliver 85° F (29° C) tepid water with high temperature limit stop at 90° F (32° C). Temperature can be adjusted in field up to limit and locked.
 - 4) Capacity. Valve shall have a flow capacity of 50 GPM (189 L/min) at 30 PSI (2.1 bar) pressure drop.
 - 5) Failsafe Protection. In event the hot water supply fails, the valve shall deliver cold water only (i.e. bypass mode) at a flow rate of 38 GPM (144 L/min) at 30 PSI pressure drop. In the event the cold water supply fails, the valve shall close and not deliver any water at all eliminating the possibility of scalding.
 - 6) Supply Pressure. Maximum supply pressure is 125 PSI. Pressure of hot and cold water supplies can vary up to 25% and still deliver the flow and temperature required by ANSI/ASSE 1071.
 - 7) Quality Control. Valve shall be third-party certified to comply with ANSI/ASSE 1071 and shall be fully assembled and factory tested prior to shipment.
 - 8) Manufacturer: Guardian G6040 thermostatic mixing valve or equal
 - b. Safety Station Sign: Provide three-sided, ABS plastic, ANSI compliant sign with mounting hardware for each emergency shower and eyewash station.
 - c. Test Kit: Provide one emergency shower and safety station test kit including Tyvek chute, 48" telescopic aluminum pole, 5-gallon plastic pail, and eyewash tester. Provide Guardian AP250-005 or equal.

B. Exterior Freeze Resistant Combination Shower and Eyewash

1. Location: Provide where scheduled or indicated on the drawings.
 - a. Install stations within 10 seconds, approximately 55', of hazard, on the same level as hazard and with unobstructed travel path.
 - b. Clearance: There shall be no barrier within a 16" radius of center point of shower head or within 6" of the eye/face wash
2. Fixture: Freeze resistant, combination eyewash and shower safety station with stainless steel bowl and ABS plastic shower head, internal 20 GPM flow control, Schedule 40 galvanized pipe and fittings, 1¼" and ¾" IPS freeze resistant stay-open bury valves with push plates (36" standard bury depth), and a 1/8" NPT bleed outlet. Unit shall have (2) polypropylene GS-Plus™ spray heads with integral "flip-top" dust covers, filters and 1.6 GPM flow control orifices mounted on a chrome plated brass eyewash assembly.
3. Performance: Unit shall meet or exceed ANSI Z358.1 – 2014 with a full 2-year warranty.
4. Manufacturer: Guardian GFR1902 or equal
5. Accessories:
 - a. Safety Station Sign: Provide three-sided, ABS plastic, ANSI compliant sign with mounting hardware for each emergency shower and eyewash station.

2.11 FIXTURE ACCESSORIES

- A. Trap and supply line covers: For all exposed trap or supply lines provide ADA and UFAS compliant, resilient molded vinyl, paintable, 1/8" min. thickness as manufactured by ProFlo or equal.
- B. Escutheons: Chrome-plated brass/stainless, for all exposed penetrations, ensuring aesthetic finish.

PART 3 - EXECUTION

3.01 GENERAL

- A. Layout of fixtures must be considered in the initial plumbing installation to allow for required clearances, offsets, material thickness, etc. All dimensional information required for installation must be collected from actual field conditions.
- B. Coordinate placement of fixtures with other trades as required.
- C. Ensure satisfactory surface conditions for floors, wall, countertops, etc. prior to installation of fixtures. Do not proceed until any unsatisfactory conditions are corrected.
- D. ADA Requirements:
 1. Properly install all ADA fixtures and associated appurtenances to comply with the ADA Standards and local codes.

2. Ensure no obstructions are installed within the clear space for each fixture except as allowed by ADA standards.
3. Provide covers on trap and supply lines where exposed.
4. Provide grab bars and other similar accessibility aids as specified in Section 10 28 00, Toilet and Bath Accessories.

E. Report to Engineer any conflicts or unsatisfactory conditions before start of construction.

3.02 INSTALLATION

- A. Set Fixtures level and in proper alignment with respect to walls and floors.
- B. Install supplies and drains in proper alignment with fixtures
- C. Install flush valves in alignment with the fixture, without vertical or horizontal offsets.
- D. Grout wall and floor mounted fixtures watertight where the fixtures are in contact with walls and floors.
- E. Caulk deck-mounted trim at the time of assembly, including fixture and casework mounted. Caulk self-rimming sinks installed in casework.
- F. Ensure water tight connections for supplies and drains.

END OF SECTION

SECTION 23 02 00

SECTION GENERAL REQUIREMENTS MECHANICAL (HVAC)

PART 1 - GENERAL

1.01 SPECIAL NOTES

- A. Refer to "General Conditions" and "Supplementary General Conditions" of the specifications. Work under this section of the specifications shall be governed by requirements thereunder.
- B. The use of the word "PROVIDE" in the specifications and on drawings for work under this section shall mean: Furnish and install complete, supplying all necessary labor and materials.
- C. This section applies to all sections of Division 23 of this project except as specified otherwise in the individual sections and here-in. Work described in this section includes general requirements common to all mechanical systems. Provisions of this section apply to all mechanical specification sections.

1.02 GENERAL REQUIREMENTS

- A. Provide necessary labor, material, plant and equipment including materials not specifically mentioned, but necessary to complete the job in a neat, correct and workmanlike manner.
- B. The drawings and specifications shall be considered as supplementary, one to the other, so that materials and labor indicated, called for or implied by the one and not the other, shall be supplied and installed as though specifically called for by both.
- C. All electrical equipment shall be UL listed and all gas equipment is to be AGA certified.
- D. All items to be properly lubricated and in perfect operation upon completion of the project and prior to final acceptance by owner.
- E. Contractor shall be held responsible for having visited job site and having familiarized himself with existing conditions prior to submitting bid. If any existing problems are identified, notify Engineer in writing prior to submitting bid.

1.03 SCOPE

- A. Provide a complete Heating, Ventilating, and Air Conditioning system as specified here-in and as indicated on the accompanying Mechanical Drawings.
- B. Provide heat pumps with auxiliary electric heaters (as shown) together with all necessary ductwork, supply and return grilles, and thermostatic control as specified and indicated on drawings.
- C. Provide exhaust fans as indicated on the accompanying Mechanical Drawings.
- D. Provide air distribution ductwork systems as indicated on plans.
- E. Insulate all ductwork, piping, and equipment as herein specified and as indicated on mechanical drawings.
- F. Provide thermostatic control for all new HVAC equipment.

- G. Provide all control, interlock and starting circuit wiring. Wiring shall be 120 volts or less. Provide transformers and relays as required to comply with this requirement. Conduit shall be galvanized conforming to the requirements of the Electrical Specifications, except as otherwise specified.
- H. Start, test, adjust, balance and place into operation all systems. The building air distribution systems are to be balanced to provide the quantity of air as shown on drawings. System air balance is to be accompanied with certified test forms as to obtained air quantities. Proper fan performance and coil discharge air temperature reading shall also be certified.
- I. All mechanical installations, equipment, ductwork, and piping shall be seismically braced or restrained as required by the International Building Code.

1.04 SPACE CONDITIONS

- A. All work shall fit the spaces available. Verify all dimensions of the work before commencing fabrication and/or installation. Minor deviations from the drawings required to conform to space conditions and to provide the required accessibility shall be made at no additional cost to Owner.
- B. Only base manufacturer's equipment has been investigated and determined to meet necessary space conditions. It shall be the responsibility of the approved equal manufacturer and contractor to verify their suitability for use on this project.

1.05 DRAWINGS

- A. The Plans are not intended to show all ductwork, pipes, valves, fittings, connections, and details of the work to be done. The piping, duct, and equipment locations shall be adhered to as closely as possible; however, any changes necessary to avoid columns, beams, lighting fixtures, ductwork, sprinkler piping, etc., shall be made at no additional cost to the Owner.
- B. Conflicts in the plans and specifications where changes and alterations are necessary, or where exceptions are taken by the Contractor with regard to sizes, locations, and other details indicated on the drawings, they shall be discussed with the Engineer and have his consent in writing before any changes are made. The Contractor shall confer with the Engineer for the exact location of all openings into finished areas and all equipment and piping locations before proceeding with the work.
- C. The drawings of this work were prepared in conjunction with the other trades and plans of the project and it shall be the Contractor's responsibility to provide himself with drawings of the other trades as required and to coordinate and schedule the work with the other trades.
- D. Should any difficulties prevent the installation of the work as indicated, the proposed changes shall be submitted to the Engineer in detail and must be approved in writing before the work may be performed.
- E. All inverts, locations, and elevations on all piping, equipment, trenches, etc. shall be verified on the job site prior to the performance of any work that may be affected in any manner by said inverts, locations, and elevations. Before construction of project starts, check location of proposed equipment and ductwork. Review other drawings for project, checking locations of structural elements, locations and sizes of chases, type and method of construction of roof, ceilings, walls, and partitions. Report to Engineer before start of construction any conflicts or unsatisfactory conditions. In no case shall Contractor proceed in uncertainty. No extra charge will be approved after start of construction for work resulting from failure to follow these instructions.
- F. Where connections and drains are provided to serve specific pieces of equipment, it shall be the Contractor's responsibility to verify the exact location of the equipment connections and drains and no

installation shall be attempted until exact locations have been established. This applies to all equipment regardless of who furnishes said equipment.

1.06 PERMITS, LICENSES, AND FEES

- A. The installation of the systems covered by these specifications shall conform in strict accordance to all ordinances, codes and regulations of the City, County, State, and/or all other authorities having jurisdiction and shall conform to all applicable requirements and recommendations of the N.F.P.A. These requirements are minimum and shall be complied with at no additional cost to the Owner.
- B. In the absence of local regulation and codes, on heating, ventilating, or air conditioning, or in items or circumstances not covered by local regulation and codes, all recommendations and requirements of the ASHRAE, as set forth in the current edition of the ASHRAE Guide, shall be met as well as all requirements and recommendations of NFPA 90A and the International Building Code.
- C. Where requirements of the drawings and specifications exceed code requirements, the work shall be provided in accordance with the drawings and specifications. Any work provided contrary to these requirements shall be removed and replaced at the Contractor's expense.
- D. The Contractor shall obtain and pay for all necessary permits and inspections required for the installation of this work and shall pay all charges incident thereto. The Contractor shall deliver to the Engineer all certificates of said inspections issued by the authorities having jurisdiction.

1.07 BID BASIS

- A. Basis of Design: The design is based on equipment data furnished by a listed "Base" manufacturer. Only this base listed equipment has been verified by the A/E for compliance with the documents. There is no intent in these documents to necessarily use only "standard" products of the "Base" supplier nor any other supplier. Modifications and alterations of standard products may be required.

1.08 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and free from flaws and defects of any nature. Materials called for are to be considered as standard of quality; which however, implies no right on part of Contractor to substitute other materials and methods without written authority from Engineer.
- B. All work shall be performed by skilled mechanics, under competent supervision, employing latest and best practices of the trade. Work shall be installed in accordance with recommendations of ASHRAE Guide, and equipment manufacturer's installation instructions. In the event there is any conflict or doubt, consult Engineer for clarification and approval.

1.09 SUBSTITUTIONS

- A. Specific reference in the specifications to any article, device, product, material, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal" shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition, and the Contractor in such cases may at his option, use any article, device, product, material, fixture, form or type of construction, which in the judgement of the Engineer, expressed in writing prior to bidding as specified below, is equal to that herein named.
- B. Refer to Substitutions: Section 01 60 00 – Product Requirements.
- C. Contractor shall be responsible for determining that all products submitted for approval meet given space limitations and maintain all required clearances for proper access and service.

1.10 SUBMITTAL

- A. Refer to Section 01 33 00 - Submittal Procedures and the provisions of requirements listed below .
1. The contractor shall submit for approval manufacturer's shop drawings of all equipment, and shop drawings to scale of all fabricated work furnished under this Section of the specifications including piping, ductwork, equipment layouts, supports and equipment foundation pad layout. Shop drawings shall be of scale large enough to clearly indicate all details of work. Mechanical rooms, boiler rooms, refrigeration plants, and fan rooms shall be submitted on a scale of not less than 1/4-inch equals one foot.
 2. Where colors or finishes are specified for products, a sample showing the color or finish shall be submitted with the shop drawings.
 3. Where high efficiency motors have been specified, submit certification of motor efficiency with shop drawings for each motor of one horsepower or greater.
- B. Material List: Accompanying the shop drawings, submit a complete list of all materials proposed to be furnished and installed under this Section, giving manufacturer's name and catalog number, sizes, capacities, model numbers, accessories and other pertinent information for each item to indicate full compliance with drawings and specifications; this shall in no way be construed as permitting substitution except as specifically provided in the elsewhere in these specifications. Every device or piece of equipment herein specified by model and manufacturer shall be submitted for approval. Partial lists submitted from time-to-time will not be permitted.
- C. Mechanical/Electrical Coordination: Before equipment is ordered and after all motors, loads, controls, and other characteristics of equipment are known, the Contractor shall review the data shown on the Electrical drawings. Special attention shall be given to motor size, starters, means of disconnect, control wiring, etc. that are being furnished under the electrical section of the specifications. At the time of shop drawing submittal, the contractor shall by letter to the Engineer point out any discrepancies and describe the proposed corrective action.
1. Prior to start of construction, contractor shall submit a starter schedule for review by Engineers. This schedule shall contain equipment description, starter manufacturer and model number, starter accessories, control voltage and source of starter power and control circuitry.
 2. No extra charge will be approved after start of construction for work resulting from failure of contractor to follow these instructions.
- D. As-Built Drawings: Contractor shall maintain on the job site one complete set of the mechanical drawings for this project. All changes authorized by the Engineer as to the location, sizes, etc., of piping, ductwork, and other mechanical equipment shall be indicated in red ink on the mechanical drawings as the work progresses. At the completion of the project, Contractor shall deliver a complete set of "As-Built" prints of the mechanical drawings to the Engineer.
- E. Control Drawings:
1. Before installation of controls, submit complete submittal data, including equipment specifications, control diagrams, schematic diagrams, internal connections, and sequence of operation to the Engineer for his approval. Diagrams shall show all instruments, devices, tubing, etc. Set points and actions of instruments, operating ranges, and normal position of controlled devices shall be indicated. Operating sequence describing each system shall appear on the same drawing as the system's control diagram.

2. Wiring diagrams shall show conduit and wire sizes, transformers, fuses and correct schematic diagrams for each motor starter and magnetic contractor. Diagram shall be coordinated with the equipment manufacturers involved and shall show the terminal designations for all connections to the equipment and the manufacturer's approval obtained.
- F. Manual: See Section 01 70 00 for required copies and the format. Each Manual shall include a copy of the As-Built Drawings, operating and maintenance instructions, approved control drawings, spare parts lists, name and address of local service representatives and all warranty certificates for new equipment.
- 1.11 ELECTRIC WORK
- A. Electrical Contractor will provide the following for the mechanical equipment:
1. A source of power as required for each electric motor and for each electrical heating and cooling item of equipment installed under the mechanical contract, including final wiring connections to motor terminals or to terminals in a control panel mounted on each respective unit.
 2. Circuit breaker protection as required for each electric heating and cooling item of equipment installed under the mechanical contract.
 3. Wiring each electric motor and each electrical heating and cooling item of equipment (where applicable) through a magnetic starter or a magnetic contactor furnished by the Mechanical Contractor.
 4. Wiring each constant speed ceiling exhaust fan through a wall switch furnished by the Electrical contractor.
- B. All motors shall be provided with thermal overload protection either internally or at the starter and all electrical equipment shall be U.L. listed.
- C. C. In the event Mechanical Contractor proposes to use any items of mechanical equipment which
- D. have sizes, numbers of electrical meters, or other electrical requirements different from those specified on schedules, drawing or elsewhere, Contractor shall be responsible for coordinating these changes with the Electrical Contractor and he shall reimburse the Electrical Contractor for all additional costs necessitated by these changes.
- E. D. In general, the Electrical Contractor will do all power wiring for the mechanical equipment as
- F. described above, and the Mechanical Contractor shall do all control and interlock wiring, unless otherwise specified or indicated on drawings.
- G. E. Consult electrical drawings for extent of electrical work provided for the mechanical equipment.
- H. Verify current characteristics with Electrical Contractor before ordering any equipment for this project.
- I. Mechanical Contractor shall provide at no additional cost all other wiring not covered above, that is necessary for complete and operating heating and air conditioning systems for the building, including all control wiring, interlock wiring, conduit, relays, controls, starters, disconnect switches, circuit

breakers, control conduit and outlet boxes, wiring of all applicable control items of equipment, and other electrical work as required.

- J. All wiring shall be run in galvanized conduit as allowed under the electrical section of the specifications. All conduit shall be attached to ceiling or walls, attachment to or suspension from other equipment will not be permitted. If routing of conduit is questionable, verify routing with Engineers before proceeding with installation.
- K. The Mechanical Contractor shall provide power wiring from the breaker panel to all control devices including but not limited to control panels, valves, thermostats, dampers, flow switches and other devices requiring power for a complete and operating mechanical system.
- L. All electrical work required under this Contract shall comply with the National Electrical Code, and shall meet all local requirements. All electric equipment shall bear UL labels.

1.12 GUARANTEES

- A. The Contractor agrees:
 - 1. To correct defects in workmanship, new materials, new equipment, and the operation of system for a period of one year from the completion of the project as a whole. Equipment and materials, repaired or replaced are guaranteed for one year following date of correction.
 - 2. To repair any damage to building and equipment resulting from defects in workmanship, materials, equipment, and system operation.
 - 3. To remove any item not specified or given approval and replace it with specified or approved item.
 - 4. Any item submitted for approval that does not conform to these specifications shall have accompanying note of exception.
 - 5. That the system as installed shall comply with code requirements.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. All equipment and materials provided under this section of the specifications shall be new and of the best grade and quality. Materials and equipment manufactured outside of the United States will not be acceptable.
- B. The approval of the Engineer shall be obtained by the Contractor on all equipment and materials before any installation is made.
- C. Equipment that is installed and then does not perform as represented by selection data or shop drawings shall be replaced with equipment that meets the job requirements and specifications at no additional cost to the Owner.
- D. All equipment, materials, and work indicated on the drawings or as specified hereinafter is intended to be installed in a manner conforming to the best engineering practices and all equipment is intended to be complete in every respect to satisfy the job requirements and this specification. In the event any material or equipment is indicated to be used or installed contrary to the manufacturer's

recommendations, or if any part, control accessory or auxiliary item required for satisfactory and proper operation and performance of the material and/or equipment is not indicated or specified, it shall be the Contractor's responsibility to notify the Engineer in writing prior to installation. In the event the Contractor fails to give such notice, he will be required to correct the work and/or furnish items omitted (in the performance of his work) at no increase in the contract sum.

- E. Upon request from the Engineer, the Contractor shall furnish to the Engineer a certification on all materials and equipment so designated by the Engineer. The certification shall be made by the manufacturer of the material and/or equipment; shall be signed by an official of the manufacturing concern; and shall state that the drawings, specifications, and project requirements have been thoroughly studied by the manufacturer and that the proposed material and/or equipment is unconditionally guaranteed to operate and/or perform properly as applied.

PART 3 - EXECUTION

3.01 UTILITY CONNECTION AND MODIFICATIONS

- A. It shall be the Contractor's responsibility to determine all requirements regarding utility services to the building. The Contractor shall verify the exact locations of stubs provided.

3.02 PROTECTION

- A. The Contractor shall provide adequate protection to all materials, equipment, fixtures, etc. provided under this section of the specifications to prevent damage of any nature. The Contractor shall be required to remove and replace, at no additional cost to Owner, any item showing any sign of damage of any nature that cannot be restored to its new condition and appearance. Grinding and polishing may be used in the restoration of damaged equipment and materials when approved by the Engineer.

3.03 3.3 EXCAVATION AND BACKFILLING

- A. Mechanical Contractor shall do all excavating and backfilling for installation of work included
 1. under this contract and he shall promptly remove from the premises all excess earth, debris, and trash for which he is responsible. Coordinate with the General Contractor for cutting and patching excavation conditions. All work shall comply with section 230500 as well as the other sections of these specifications.

3.04 3.4 CUTTING AND PATCHING

- A. A. The Mechanical Contractor will do all cutting and the General Contractor shall do all patching and construction of chases within building for this installation. Mechanical Contractor shall advise General Contractor well in advance of sizes and locations of all openings, sleeves, etc., required. Failure to do so will result in Mechanical Contractor bearing cost of this phase of the work.

3.05 3.5 PENETRATIONS AND CURBING

- A. General Contractor shall provide framed openings in roof and walls as required for exhaust fans and louvers. Mechanical Contractor shall coordinate with General Contractor and provide General Contractor with sizes and locations of these and all other necessary penetrations well in advance. Failure to do so will result in Mechanical Contractor bearing cost of this phase of the work.

- B. Mechanical Contractor shall provide all roof curbs for this installation and General Contractor will flash all roof curbs and penetrations as detailed on drawings.

3.06 MECHANICAL - ELECTRICAL COORDINATION

- A. A. Mechanical equipment, piping, and ductwork shall be installed with clearances to electrical switchboards, panelboards, power panels, motor control centers, and transformers. The clearances shall be the greater of the requirements of the NEC in front of the equipment. Mechanical equipment, ductwork or piping shall not be installed directly over the electrical gear and not less than 3'-0" horizontally from the top of the electrical gear.

3.07 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall acquaint and instruct the Owner's representative with all details of performance, operation, and maintenance of the systems.
- B. The basis of Owner's instructions shall be written for inclusion in the maintenance and operating instructions data specified above. Obtain certificates, signed by the Owner's representative, that these instructions have been received and understood.

3.08 CLEANING

- A. The Contractor shall keep the job site clean, removing all debris and unused material as they occur. At the completion of the work, the Contractor shall thoroughly clean all materials and equipment provided as part of the work.
- B. Prior to testing and adjusting, all piping systems, including all components of systems, shall be thoroughly cleaned inside and out.
- C. All soil, waste, drain and rainwater lines shall be rodded out in the presence of the Engineer's representative. All cleanout plugs shall be removed, lubricated and replaced.
- D. Painting of the mechanical equipment shall be as specified under other sections of the work. Removing loose scale, rust, drippings, dirt, etc. in preparation for painting shall be done under this section of the specifications.
- E. Prior to acceptance of the building, thoroughly clean all exposed portions of the HVAC installation, removing all labels and all traces of foreign substances, using only a cleaning solution approved by the manufacturer of the item being cleaned. Caution should be taken to avoid damage to all finished surfaces.

3.09 START-UP

- A. The Contractor shall place the systems in full operation before testing begins. The Contractor shall make corrections in the system, including furnishing and installing drives, motors, dampers, valves, etc., if required to balance the systems. All such corrections shall be included in the Contractor's base bid and shall be accomplished at no additional cost to the Owner. All piping shall be tested before covered with insulation or being concealed.

END OF SECTION

SECTION 23 03 00

HVAC PRESSURE TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work in this section includes the pressure testing of all air conditioning systems and includes requirements common to all the mechanical systems. Provide all labor, tools instruments, etc. as required to completely test the systems.
- B. Other sections of these specifications are a part of this section. Refer to all other sections for a complete description of the work. Work, conditions, and materials specified in other sections and not duplicated in this section includes, but is not limited to the following:
 - 1. Mechanical General Provisions.
 - 2. Basic Materials and Methods.
 - 3. Refrigeration.
 - 4. Adjusting Balancing HVAC Systems.
- C. All work provided under these specifications shall be subject to constant inspection and final approval of the Engineer and all Code authorities having jurisdiction. Tests, in addition to these specified herein, required to prove Code compliance shall be provided as required by the Authorities without additional cost to the Owner. All work found to be defective or indicating leakage shall be repaired or replaced with new materials, as directed by the Engineer. Tests shall be repeated until all work is proven tight.

1.02 QUALITY CONTROL

- A. All tests shall be conducted by qualified personnel. When requested the qualifications of individuals shall be submitted to the Engineer for approval.

1.03 NOTIFICATION

- A. The Engineer shall be notified prior to all tests. Provide a minimum of 48 hours' notice.
- B. The Code Authorities having jurisdiction shall be notified prior to all tests.

PART 2 - PRODUCTS

2.01 PROVIDE ALL MATERIAL, TEST EQUIPMENT, INSTRUMENTS, AND LABOR REQUIRED FOR THE TESTS. ALL INSTRUMENTS SHALL BE PROPERLY CALIBRATED AND SHALL HAVE RECORDS ON CALIBRATION.

PART 3 - EXECUTION

3.01 DUCTWORK

- A. A. Supply ducts shall be tested with a calibrated orifice and fan before grilles, registers, diffusers, and ceiling are installed. Low pressure sheet metal duct losses shall not exceed 10% of the design system CFM at 2" W.G. Seal if required. Medium pressure ducts shall be tested as recommended by SMACNA Manual. Fiberglass ductwork does not require pressure testing.

3.02 REFRIGERANT PIPING PRESSURE TESTING

- A. After Freon piping has been completed and before insulating pipe and enclosing chases, the field installed piping shall be pressure tested at a pressure of 300 psi (high side) and 150 psi (low side). While the system is being pressure tested, an electronic leak detector shall be used to check for leaks.
- B. Pressure shall be maintained on piping for a minimum of 12 hours. All field installed piping shall be evacuated when surrounding ambient air is not less than 60 degrees F. A minimum vacuum of 2.0 mm of mercury shall be pulled on piping system and maintained for 12 hours. The vacuum pressure displacement shall be not less than 5 CFM. The vacuum shall be checked with an electronic gauge.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Piping materials and installation instructions common to most piping systems.

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

- A. Unless otherwise specified and in addition to provisions of the General Conditions, submit drawings having each sheet, and each page of a brochure, marked with identification and containing information described below. Submittals are to be complete, partial submittals will not be accepted.
- B. Identification:
 - 1. Include project name and Architect's job number. If pages are securely bound in brochure, this is needed on cover only.
 - 2. Identification by specification section and article under which equipment or material is described, and by name, number and intended use as designated by contract drawings and specifications.
 - 3. When more than one item of equipment is covered by a single drawing or catalog cut, each project equipment item must be separately identified thereon with clear delineation as to which model or catalog number or performance data applied to each project item.
- C. Information:

1. Include manufacturer's model number or catalog number, size and other data as requested.
2. Maintenance Manuals: Organize each maintenance manual with index and thumb-tab marker for each section of information; bind in 2-inch (51-mm) 3-ring, vinyl-covered binder, with pockets for folded sheets, properly labeled on spine and face of binder.

1.04 QUALITY ASSURANCE

- A. Application: HVAC work shall comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to extent more detailed and stringent requirements are indicated or required by governing regulations.
- B. Listing of Associations, Standards and Abbreviations Specific to HVAC Work (in addition to standards specified in individual work sections), conform to following applicable standards:
 1. AABA - Associates Air Balance Council
 2. AGA - American Gas Association
 3. AMCA - Air Movement & Control Association
 4. ARI - Air/Conditioning and Refrigeration Institute
 5. ASC - Adhesive and Sealant Council
 6. ASHRAE - American Society of Heating, Refrigeration & Air Conditioning Engineers
 7. ASME - American Society of Mechanical Engineers
 8. ASPE - American Society of Plumbing Engineers
 9. ASSE - American Society of Sanitary Engineering
 10. AWS - American Welding Society, Inc.
 11. AWWA - American Water Works Association, Inc.
 12. CAGI - Compressed Air and Gas Institute
 13. CISPS - Cast Iron soil Pipe Institute
 14. EPA - Environmental Protection Agency
 15. FM - Factory Mutual System
 16. MCA - Mechanical Contractor's Association of America
 17. NIST - National Institute for Standards and Technology
 18. (NBS) (formerly National Bureau of Standards)
 19. NEC - National Electrical Code by NFPA
 20. NEMA - National Electrical Manufacturer's Association
 21. NFPA - National Fire Protection Association

- 22. NSF - National Sanitation Foundation
 - 23. OSHA - Occupational Safety and Health Administration (U.S. Department of Labor)
 - 24. PDI - Plumbing and Drainage Institute
 - 25. SMACNA - Sheet Metal & Air Conditioning Contractors National Associations, Inc.
 - 26. TIMA - Thermal Insulation Manufacturers Association
 - 27. UL - Underwriter's Laboratories, Inc.
- C. Symbols: Except as otherwise indicated in drawing legends, refer to "ASHRAE Handbook of fundamentals" for definitions of symbols used on the drawings to show mechanical work.
 - D. Manufacturers: Firms regularly engaged in the manufacture of products of quality, types and sizes required; and which have been in satisfactory use of not less than four years in similar service, except as otherwise noted in specific sections of this division.
 - E. Installer's Qualifications: Firm with at least three years of successful installation experience on projects with work similar to this project and meet applicable regulatory agencies requirements.
 - F. Compatibility: Provide products which are compatible with other products of the plumbing work, and with other work requiring interface with the plumbing work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.
 - G. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
 - H. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
 - I. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
 - J. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- 1.05 DESCRIPTIONS
- A. "Owner Purchased" and "Contractor Purchased" equipment is described in Division 00 Section General Conditions." Unless the Drawings indicate that it Owner purchased, the Contractor is responsible for purchasing the equipment as shown on Drawings.
 - B. Section specifies provisions for HVAC work, including:

1. Certain adaptive expansions of requirements specified in Division 00 Section General Conditions”, uniquely applicable to HVAC work.
 2. General performance requirements within HVAC work (all Division 23 Sections) as a whole.
 3. General work to be performed as HVAC work, because of its close association with HVAC work.
- C. Examine all Drawings, and visit site and become acquainted with all conditions which may affect execution of work.
 - D. Provide work in accordance with state and local codes, regulations and/or ordinances, and meet approval of authorities having jurisdiction. Provide only new material and as specified.
 - E. Furnish to Owner Representative, a Certificate of Final Approval from governing authority prior to Owner Representative’s final acceptance, where applicable.
 - F. Comply with all requirements for permits and licenses, and pay all associated costs.
 - G. Provide piping specialties and condensate drain piping for air conditioning units.
- 1.06 COORDINATION OF HVAC WORK:
- A. Refer to Division 00 Section General Conditions” for general coordination requirements applicable to entire work. The Contract Documents are diagrammatic in showing certain physical relationships which must be established within HVAC work, and in its interface with other work, including utilities, control and electrical work, and that such establishment is Contractor’s exclusive responsibility.
 - B. Arrange HVAC work in a neat, well organized manner, with piping and similar services running parallel with primary lines of the building.
 - C. Give right-of-way to piping as required for slope.
 - D. Locate operating and control equipment properly to provide easy access, and arrange entire HVAC work with adequate access for operation and maintenance.
 - E. Advise other trades of openings required in their work for the subsequent move-in of large units of HVAC work (equipment).
 - F. Coordination of Drawings: For locations where elements of HVAC (or combined HVAC, plumbing, fire protection and electrical) work must be sequenced and positioned with precision in order to fit into the available space, provide to Contractor coordination drawings (shop drawings) showing the actual physical dimensions (at accurate scale) required for the installation. Prepare and submit to the Contractor coordination drawings prior to purchase/fabrication/installation of any of the elements involved in the coordination.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Compatibility: Provide products which are compatible with other products of the HVAC work, and with other work requiring interface with the HVAC work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.

PART 3 - SUBSTITUTIONS AND EQUIPMENT SELECTION:

- A. First listed manufacturer shown in Specifications and Drawings was used for design basis, layout, performance and indication of style and appearance.
- B. Equipment selected from this list of manufacturers, other than design basis, must be compatible with the facility and meet requirements of the Contract Documents.
- C. If any changes are required to the Work scope, due to the selected equipment being different from the design basis equipment, Contractor is responsible for coordinating increases or decreases in Work scope, paying Contractor's cost increases and any consultant fees.

3.02 CONDENSATE PIPING

- A. Drain Piping: Provide condensate drain piping from HVAC units as required to complete the system. Provide piping of Schedule 40 PVC. Trap and pipe as required.

3.03 PIPING SPECIALTIES

- A. Provide factory fabricated drainage piping, fittings and specialties recommended by manufacturer.
- B. Pipe Escutcheons: Provide pipe escutcheons with inside diameter close to outside diameter of pipe or outside diameter of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls or ceilings; and pipe sleeve extension, if any. Unless other indicated, furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

3.04 FABRICATED PIPING SPECIALTIES:

- A. Pipe Sleeves: Provide pipe sleeves of one of the following:
 - 1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams or welded longitudinal joint.
 - 2. PVC Pipe: Fabricate from Schedule 40, PVC

3.05 BASIC SUPPORTS AND ANCHORS:

- A. General: Provide supports and anchors in accordance with the following listing:
 - 1. Adjustable steel clevises, for horizontal piping hangers and supports.
 - 2. Two bolt-riser clamps, for vertical-piping clamps.
 - 3. Concrete inserts, c-clamps, malleable beam clamps and steel brackets for building attachments.

3.06 HVAC SYSTEM IDENTIFICATION:

- A. Provide identification for HVAC equipment including but not limited to:
 - 1. RTU's
 - 2. Exhaust Fans
 - 3. Supply Fans
 - 4. Hoods
 - 5. Air Handlers
- B. Text: Description, unit number, and location.
 - 1. Example: "RTU-5 PHARMACY".
- C. Interior Identification: Provide either of the following interior identification methods:
 - 1. For open structure, provide stencil-painted identification with lettering size not less than 1-1/2-inches (38-mm) located in an easily visible location such as on the ductwork entering building from the roof.
 - 2. Where ceilings conceal the unit from sight, identify location with an engraved hard black plastic tag, 1 inch by 2 inch (25 mm by 50 mm) plate with 3/4 inch (19 mm) white lettering, pop riveted to the ceiling suspension grid directly below the location of the RTU or other piece of equipment.
- D. Exterior Identification (For equipment that does not have identification applied at the factory)
 - 1. Stencil-Painted Identification: Lettering size not less than 1-1/2-inches (38-mm).
 - 2. Engraved Plastic-Laminate Signs: Sufficient size to convey adequate information at each location. Comply with recognized industry standards for color and design.
 - 3. Operational Tags: Plasticized card stock, with pre-painted or hand printed, to convey the message; example: "DO NOT CLOSE THIS VALVE EXCEPT WHEN BURNER IS OFF". Provide proper and adequate information on operation and maintenance of HVAC systems.

PART 4 - EXECUTION

4.01 PIPING SYSTEMS – COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
 - 1. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

2. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
3. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
4. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and clearance for light fixtures.
5. Install piping to permit valve servicing.
6. Install piping at indicated slopes.
7. Install piping free of sags and bends.
8. Install fittings for changes in direction and branch connections.
9. Install piping to allow application of insulation.
10. Select system components with pressure rating equal to or greater than system operating pressure.
11. Install escutcheons for penetrations of walls, ceilings, and floors.
12. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - a. Pipe Sleeves:
 - 1) For pipes passing through brick or concrete walls, or concrete floor slabs, provide steel pipe sleeves, two sizes larger than the pipe for which they are intended. Coordinate setting of sleeves as construction progresses. Set sleeves flush with finished line of walls and floors.
 - 2) Caulk sleeves through foundation walls to make them watertight.
 1. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and HVAC sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing HVAC sleeve seals.
 - b. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - c. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - d. HVAC Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble HVAC sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

13. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using HVAC sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing HVAC sleeve seals.
 - a. HVAC Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble HVAC sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make water-tight seal.
14. Verify final equipment locations for roughing-in.
15. Refer to equipment specifications in other Sections for roughing-in requirements.
16. Where a pipe slot is indicated for a group of pipes passing through a wall, set a rectangular frame of structural angles, welded in the slot, at each side of wall. Close each side of opening with two No. 16 USG galvanized steel plates cut to fit the pipes and/or pipe insulation closely, and fasten to angle frame. For slots in exterior walls, slip flanged ferrules of sheet metal on pipes when they are installed, with flanges inside the closure plates at exterior wall face, caulk ferrules and plates to make weathertight joint, and pack space between closure plates with rock wool or glass fiber. At slots in fire walls, pack as specified above, but omit ferrules and caulking.

4.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems:
 1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 6. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators.

7. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
8. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - c. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - d. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - e. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - f. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
9. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
10. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - a. Plain-End Pipe and Fittings: Use butt fusion.
 - b. Plain-End Pipe and Socket Fittings: Use socket fusion.
11. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

4.03 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

4.04 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

- D. Install equipment to allow right of way for piping installed at required slope.
- E. Follow manufacturer's suggested procedure for protection of equipment which will be idle for an extended period of time prior to start-up
- F. Mount and align equipment in strict accordance with manufacturer's recommendations and in accordance with procedures described below. In case of conflict, these procedures govern. Where structural or miscellaneous steel is not drilled, drill in field as directed.
- G. Lubricate all equipment as required and in accordance with manufacturer's recommendations. Furnish required lubricants.
- H. Neatly cut all openings in roof decks as needed for equipment, duct and pipe penetrations.
- I. Suspend Equipment, Piping and Ductwork:
 - 1. Provide structural steel and steel rod hangers, rigid in appearance. Weld (with approval of Architect where attaching to building steel) structural steel hangers or bolt with hex head machine bolts and with spring lock washers under nuts.
 - 2. For suspension from concrete, provide steel or malleable iron inserts in poured concrete construction, as specified for pipe hangers and supports, and expansion shields, toggle bolts or lag screws, in other construction. Use electric drill with carbide bit for drilling concrete blocks.
 - 3. For suspension from structural steel, use beam or channel clamps with locking clips.
 - 4. Do not support HVAC components from ceiling grids.
 - 5. Do not suspend hangers from roof decks.
 - 6. Suspend from roof trusses and joists/joist girders only at panel points, at top cord only, unless otherwise indicated.
 - 7. Provide additional supports wherever needed, and structural steel members attached to building frame to provide additional points of support where required. Do no drilling of building structural and miscellaneous steel, except as directed or indicated.
- J. Hanger Rods and Hanger Spacing: 8-feet to 10-feet (2.4-m to 3-m) spacing maximum, provide auxiliary angles spanning between joints, as required. Comply with current A.S.M.E. code for pressure piping. Piping 5-inches (127-mm) size and larger to be supported by a minimum of two joists, with pipe center between joists.
- K. Insulated Pipe: Fit pipe hangers over outside diameter of insulation; provide sheet metal saddles 16 gage, 6-inches (152-mm) long by 1/3 of the circumference.
 - 1. Select supports for a minimum safety factor of five.
- L. Rooftop Mounted Equipment Set on Structure:
 - 1. Weld or bolt equipment to roof curbs or structural supports. For bolting equipment directly to structural supports, provide machine bolts, lock washers and nuts.
- M. Floor-Mounted Equipment:

1. Set and level equipment on foundation. Grout in place, using non-ferrous grout. Provide wedges and shims for leveling.
 2. Accurately align equipment prior to operation.
- N. Maintain daily log of operational data on HVAC equipment and systems through the close-out period; record hours of operation, assigned personnel, fuel consumption and similar information; submit copy to Owner Representative.
- O. Turn Over of Operation: Upon substantial Completion, turn over prime responsibility for operation of HVAC equipment and systems to Owner's personnel. However, until time of final acceptance, respond promptly with consultation and services, as required. Provide one operating engineer, who is completely familiar with the work, to consult with and continue training Owner personnel.
- 4.05 INSTALLATION OF CONDENSATE PIPING:
- A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leakproof piping systems. Install piping with a minimum of offsets.
 - B. Accurately cut pipe to measurements established at the site and work into place without springing or forcing. Install piping with sufficient flexibility to adequately provide for expansion and contraction due to temperature fluctuation inherent in its work operation.
 - C. Do not conceal piping in walls or partitions nor underground or under the floor. Where pipe passes through building structure, pipe joints are not to be concealed, but located where they may be readily inspected.
 - D. Discharge condensate water to comply with requirements of local jurisdiction.
 - E. Run pipes to be insulated as shown as required with sufficient clearance to permit application of insulation.
 - F. Use cadmium plated or galvanized nuts and bolts with self locking type nut or double nut on pipe clamps. Use double nuts or self locking nuts on hanger rods for piping support.
 - G. Connect condensate drain piping to HVAC equipment in manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.

PART 5 - CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete Slabs."

5.02 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Sections "Structural Steel" and "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

5.03 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

5.04 HVAC SYSTEM IDENTIFICATION

1. Provide stencil-painted identification on rooftop equipment when not provided by manufacturer.
2. Provide engraved plastic-laminate signs at locations of major equipment units, primary control devices, emergency equipment, dangerous elements of HVAC work and similar places. Mount permanently in an appropriate and effective location.
3. Operational Tags: Provide proper and adequate information on operation and maintenance of mechanical systems.

5.05 INSPECTION

- A. Installer must examine areas and conditions under which products are to be installed. Notify Owner Representative, in writing, of conditions detrimental to proper completion of work. Starting of installation constitutes acceptance.

5.06 CUTTING AND PATCHING

- A. Comply with Division 00 Section "General Conditions" for cutting and patching of other work, to accommodate the installation of HVAC work. Except as individually authorized by the Architect, cutting and patching of HVAC work to accommodate the installation of other work is not

permitted, other than necessary penetrations of HVAC sheet metal work for electrical conduit and similar purposes.

5.07 TRIMMING

- A. Inspect ductwork, pipe supports, in occupied and equipment spaces for sharp angles which protrude into path of occupants and may cause injury. Trim such protrusions or cover with suitable spongy material to prevent such injuries.

5.08 TOUCH-UP

- A. Touch-up with zinc dust-zinc oxide primer galvanized or steel equipment which has been welded or otherwise scarred. Provide additional finished equipment with paint type and color to match original.

5.09 AIR FILTER MEDIA

- A. Provide necessary filter changes for equipment operated during building construction. Replace each set of filters with clean filters at time of project close-out.

5.10 SYSTEM TESTS

- A. Perform system tests in the presence of Owner Representative. Notify Owner Representative of system's tests at least 48 hours in advance.

5.11 SYSTEM INSPECTION

- A. Systems are to be inspected by Owner Representative before covering, enclosing or concealing of work. Notify Owner Representative of systems which are to be covered, enclosed or concealed at least 48 hours in advance.

END OF SECTION

SECTION 23 05 01

HVAC BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 1.1 DESCRIPTION

- A. The use of the word "PROVIDE" in the specifications and on drawings for work under this section shall mean: Furnish and install complete, supplying all necessary labor and materials.
- B. This section applies to all sections of Division 23 of this project except as specified otherwise in the individual sections and here-in. Work described in this section includes general requirements common to all mechanical systems. Provisions of this section apply to all mechanical specification sections. Work described in this section includes construction materials and methods of installing equipment common to all mechanical systems. Provisions of the section apply to all Division 23 mechanical specifications sections.
- C. Mechanical General Provisions apply to work specified in this section.

PART 2 - PRODUCTS AND METHODS

2.01 2.1 FLASHING

- A. Ductwork and HVAC Equipment: Cap flashing for all ducts and other types of ventilating equipment which pass through or mount on the roof shall be furnished and installed under this section of the specifications. The material shall be of the same materials as the ducts, etc. to which it shall be fastened unless otherwise noted. The cap flashing shall be made tight to the duct, waterproofed, and extended over the base flashing and down the side for not less than 4 inches. The cap flashing shall be formed to provide a spring action against the base flashings. In cases of dissimilar metals between the cap and base flashings, an isolation membrane shall be installed to prevent electrolysis.
- B. Flashing for pipes passing through the roof shall be provided as indicated on the drawings or as approved by the Engineer.

2.02 PIPE SLEEVES

- A. All pipes passing through walls, floors, ceilings, all fire rated partitions, etc. shall be provided with pipe sleeves made of galvanized steel pipe unless specifically noted otherwise. Sleeves through partitions and walls shall be of the same length as the wall thickness. Sleeves set in concrete slabs shall be set flush with the underside of the slab and shall extend 1/2 inch above the finish on top of the slab. Where sleeves are in fire rated construction, the voids between the sleeves and the piping passing through insulated piping shall be of sufficient size to allow insulation to pass through the sleeve freely. Where pipes pass through walls below grade or through any floor slabs, the space between the pipe and sleeve shall be finished caulked water tight with silicone caulking.
- B. At the Contractor's option sleeves 8 inches in diameter and larger may be formed of 16

gauge galvanized steel with welded butt joints. The metal finish shall be restored after welding.

2.03 FIRESTOPPING MATERIALS

- A. Where pipe, ducts, conduit, wiring, or other mechanical equipment passes through fire rated walls, floors, or partitions with ratings of one-hour or greater, firestopping materials shall be placed in the voids between the equipment and the rated building material. Sleeves in rated construction shall have voids between sleeves and duct or pipe filled with firestopping materials.
- B. Firestopping Materials shall have a fire rating equal to or greater than the construction penetrated. Firestopping material shall not produce toxic smoke when exposed to flame. Firestopping shall be unaffected by vibration, normal usage, and shall not deteriorate with time.
- C. Firestopping materials shall be Chase-Foam as manufactured by Chase Technology Corp. or Silicone RTV Foam (3-6548 Silicone) as manufactured by Dow Corning or 3M "CP-25" caulk system. Where permitted by Code, fire rated mineral wool may be used for applications approved by the Engineer. All fire stopping systems shall be installed in strict compliance with manufacturer's instructions for compliance with UL listings.
- D. Firestopping in the mechanical room shall be recessed 3/4-inch on both sides and shall be sealed on both sides with 3/4-inch of acoustical sealant.

2.04 PENETRATIONS AND CURBING

- A. General Contractor shall provide framed openings in roof and walls as required for exhaust fans and louvers. Mechanical Contractor shall coordinate with General Contractor and provide General Contractor with sizes and locations of these and all other necessary penetrations well in advance. Failure to do so will result in Mechanical Contractor bearing cost of this phase of the work.
- B. Mechanical Contractor shall provide all roof curbs for this installation and General Contractor will flash all roof curbs and penetrations as detailed on drawings.
- C. Mechanical Contractor shall provide all roof equipment support rails for this installation and General Contractor will flash all support rails and penetrations as detailed on drawings.
- D. Curbs shall be welded galvanized steel construction minimum 18 ga. with wood nailer, 1 1/2" rigid insulation on interior, counter flashing cap, and damper shelf as required. Unless specified elsewhere curbs shall be a minimum of 12" high with interior dimensions as required by unit dimensions. Curbs shall be Creative Metals, Inc. Series CSSF, Conn-Fab, or approved equal. Curbs shall be compatible roof system. Verify roof construction and pitch prior to ordering curbs. Provisions shall be made within curbing penetrations for routing of power wiring and control wiring to equipment to prevent the necessity of a second roof penetration for this purpose.
- E. Equipment Support Rails shall be welded galvanized steel construction minimum 18 ga. With wood nailer, 1-1/2" rigid insulation on interior, counter flashing cap, and damper shelf as required. Unless specified elsewhere curbs shall be a minimum of 12" high with interior dimensions as required by unit dimensions. Curbs shall be Creative Metals, Inc. Series ESSSF, Conn-Fab, or approved equal. Support Rails shall be compatible roof system. Verify roof construction and pitch prior to ordering rails.

- F. Where walls are penetrated for louvers, ducts, or vents, appropriate lintels shall be provided to support structure and shall comply with the requirements of the structural drawings and specifications.

2.05 FLOOR, WALL AND CEILING PLATES

A. General:

- 1. Where exposed to view, all piping or duct passing through or into floors, walls, partitions, and ceilings shall be provided with escutcheon plates or flanges. The Plates or flanges shall fit snugly around the pipe, or the pipe insulation for insulated lines, and shall cover completely the pipe opening and sleeves. Plates shall be fabricated of minimum 16 gauge galvanized steel as appropriate to allow field painting. All plates shall be painted to match surrounding finish.

B. Unfinished Areas:

- 1. In unfinished areas, the plates or flanges shall be constructed of not less than 16 gauge galvanized sheet metal. Equipment rooms with furred ceilings will be considered as unfinished areas.

2.06 ACCESS PANELS

- A. Access panels shall be provided for access to all equipment, valves, piping, dampers, etc. furnished under this section of the specifications and requiring access. Dampers with operating control through the ceiling will not require access. The panels shall be located as indicated on the drawings and/or as required for adequate access. The exact locations of the access panels shall be as approved by the Engineer.

- B. Walls and Ceilings: Furnish and install steel doors in sidewalls, in walls of chases, in inaccessible ceiling, and other locations as indicated or required for ready access to service valves, balancing valves, automatic air vents, balancing dampers, and other items as applicable. Access doors shall be a minimum of 24" x 24" in size where applicable, and shall be furnished with screwdriver operated cam lock doors and a gray prime coat finish. Access doors shall have the same fire rating as the walls, floors, or ceilings in which they are installed. Access doors shall be Miami-Carey Co. Model HP and (as applicable) or approved equal.

- C. All panels located in fire rated walls or partitions shall be 1-1/2 hour B rated doors.

- D. Ductwork: Furnish and install steel access doors where indicated and/or required for access to motor operated dampers, controls, filters, louvers, fire dampers, and any other operable devices. Access doors shall be minimum 18" x 18" in size and shall be fabricated of minimum 24 gauge galvanized steel hinged to a fastening device to give an air tight closure on neoprene or felt gasket. Doors for insulated duct shall be double panel construction with 1" rigid insulation material between metal panels. Access doors shall be Ruskin AD-1275, Series ADH-22 or approved equal.

- E. Suppliers of Comparable Products: Krueger, Miami-Carey, Ruskin.

2.07 PAINTING AND LABELLING

- A. All factory applied finishes on equipment and materials that are damaged in any fashion shall be restored to their original finish in a manner as approved by the Engineer.

- B. Where the Interior of any duct is exposed to view or can reflect light as viewed from a habitable space the interior surfaces shall be primed and painted flat black or as otherwise approved by the Engineer.
- C. Where colors or finishes are specified in this section of the specifications to match adjacent surfaces and the colors or finishes of the product installed do not match the contractor shall repaint or refinish as required to accomplish the desired effect, as approved by the Engineer.
- D. All finish painting shall be performed under another section of the specification, except as specified otherwise in this section of the specification.
- E. Mechanical Contractor shall paint all exposed piping, both insulated and uninsulated that is installed under his contract. Refer to piping specifications for painting specifications.
- F. Paint and label all piping or insulation around piping according to existing color scheme. If no existing color scheme exists, use standard colors as indicated in Chapter 34 (PIPING SYSTEM IDENTIFICATION) of 1997 ASHRAE.FUNDEMENTALS. Submit proposed colors and markings to Engineer for approval.
- G. Engraved plastic nameplates shall be provided for each piece of equipment installed on this project. Lettering shall not be less than one-quarter inch high. Mechanically fasten nameplates to fixed surface on equipment or on walls immediately adjacent to each piece of equipment. Label all equipment with tag indicated on mechanical schedules and details, i.e., HP-1, AHU-1, CP-1, etc. in addition to this minimum information, where a piece of equipment is dedicated to and individual room or area, the device label shall include the area designation/room number. Prior to fabricating labels, contractor shall obtain room/area designations from Engineers for compliance with final building signage. Refer to Sections 232300, 233000, and 230900 for additional labeling requirement for system components.

2.08 OUTDOOR UNIT SUPPORTS

- A. Units on grade: Mechanical Contractor shall provide a reinforced concrete pad for each outdoor unit located on grade. Concrete shall be reinforced with No. 4 rods twelve (12) inches on center. Pad shall extend six (6) inches beyond the edge of the unit. The top of the pad shall be a minimum of four (4) inches above finished grade.
- B. Units on roof: Mechanical Contractor shall provide equipment support rails for each outdoor unit located on roof. Equipment support rail shall be as specified here-in. Mechanical Contractor shall coordinate with General Contractor on support rail placement to insure proper support and installation.

2.09 STRUCTURAL ATTACHMENTS

- A. A. Concrete fasteners shall be self-drilling type, Locke Mfg. Co. "Bull Dog", Phillips "Red Head", or Diamond "Blue-Cut".
- B. Mechanical Contractor shall provide all supplementary steel, framing members, beam clamps, hanger rods, etc., as required to properly support equipment and ductwork.
- C. Hanger rods shall be selected to safely carry the load to be supported and shall not be less than the diameter listed by the hanger manufacturers for the specific size hanger used.
- D. Attachment:

1. Piping and equipment suspended from steel construction shall be suspended from beams from the panel points of the bar joist only. When the hanger point is not directly below a structural member of a joist panel point, supplementary supporting steel shall be provided to receive the bridge across the structural member of a joist as required to receive the hanger. The hangers and supporting steel shall not be attached to the roof deck construction.
 2. Hangers and supporting steel shall be attached to new concrete construction with continuous metal inserts designed to be used in ceilings, walls, or floors. In no case shall the load imposed on an insert exceed the manufacturer's recommended loading.
 3. Hangers and supporting steel shall be attached to existing concrete structure, using concrete drill anchors at location and in a manner as approved by the Engineer. Anchors shall not be loaded beyond their published ratings. Refer to Section 05 05 19 – Post Installed Concrete Anchors.
- E. Support ducts from building structure with galvanized steel hangers to each side of duct. Hangers for ducts up to 60 inches maximum side dimension shall be 1" X 1/8" galvanized steel band. Hangers for larger ducts shall be 1-3/8" X 1/8" galvanized steel band. Space hangers on 8 foot centers with three hangers at each branch or take-off.
- F. Steel pipe passing through a concrete slab on grade shall have modular expanding seals between pipe and sleeve. "Link-Seal" or an approved equal.
- 2.10 2.10 FOUNDATIONS, HANGERS, AND SUPPORTS
- A. The Contractor shall provide all necessary hangers, supports, bracing, accessories, etc. required for proper installation of the work. Pipe hangers shall be spaced close enough to maintain proper grade and prevent sagging, but in no case shall the hanger spacing be greater than specified hereinafter. Special care shall be taken in supporting piping subject to expansion and contraction so that the piping does not become improperly aligned or anchored.
- B. Unless specifically indicated otherwise, all concrete foundations and all structural steel, other than the building structure or special supports provided under another section of the specifications, required for proper support of piping, equipment, and materials provided under this section of the specifications and shall be furnished and installed under this section of the specifications and shall comply in strict accordance with all requirements of the Structural and/or Concrete Sections.
- C. All supplementary steel exposed to the weather shall be hot-dipped galvanized.
- D. Unless otherwise indicated, all floor mounted equipment located in the Equipment Room and spaces shall be mounted on 4" high concrete bases extending 6" beyond the bases of the equipment in each direction. Concrete shall be reinforced with No. 4 steel rods spaced 12" on center in both directions, except that steel in pump bases shall be on 6" centers.

2.11 ELECTRICAL

- A. All motors required for all equipment furnished under this section of the specifications shall be provided under this section of the work. Two speed motors shall be two winding type unless otherwise indicated. Unless otherwise indicated under the Electrical work or on the Mechanical Drawing, motors smaller than 1/2 HP shall be for 115 volts, single phase, 60 cycle power, and motors 1/2 HP and larger shall be single or three phase 60 cycle power as indicated on equipment schedules.

- B. All motor starters, both manual and magnetic, and pushbutton stations required for motors furnished under this section of the specifications shall be provided under this section of the work unless specifically noted or indicated or otherwise in the Electrical section. All starters shall have "HAND-OFF-ON" switches and auxiliary contactors. Control transformers shall be provided as needed to meet control requirements. All two-speed starters shall be for two winding motors and shall have decelerating relay between high speed and low speed. All starters shall have compelling low speed start relay. All starters shall be installed under the Electrical Section of the specifications, unless furnished as an integral part of the equipment. All starters shall be of the same manufacturer as the starters furnished under the Electrical Section, except starters for water chillers may be of a different manufacturer. Coordinate with the Electrical Section.
- C. Motors one horsepower and larger, including those used for pumps, air units, fans, etc. shall be designed in accordance with NEMA Standard MG1, Design B, Class B or F insulation for 40 degrees C temperature rise. The motor power factor at full load and rated voltage for motors with greater than 1 HP output shall be at least 0.85 Power factor shall be as determined by IEEE Standard 112A Method B. Apparent efficiency (Nominal Efficiency x Power Factory = Apparent Efficiency) shall meet or exceed the following:

Totally Enclosed Air-Cooled Motors:			
Horsepower	Nominal Efficiency	Power Factor	Apparent Eff. %
1	82.5	83.9	69.2
1 1/2	83	86.3	71.6
2	84	84.0	70.6
3	85.4	86.6	73.9
5	86.5	81.0	70.0
7 1/2	88.5	87.0	77.0
10	89.3	86.6	77.3
15	89.8	87.5	87.6
20	90.9	85.8	78.0
25 and larger	90.9	89.0	80.9

- D. All power wiring shall be provided under the Electrical Section of the specifications, unless specifically noted otherwise in this section of the work. Power wiring between starters and applied equipment motors shall be provided under the Electrical Section. Power wiring that is furnished under the Electrical Section to Packaged Equipment such as rooftop units, condensing units, electric heating equipment, packaged house pumping systems, etc. shall consist of a single point connection and shall terminate with the connection to the units. Single point power connection shall be furnished as part of the package or shall be furnished under the Mechanical Section of the work.
- E. All electrical devices and equipment including, but not limited to, all motors, starters, relays, pushbuttons, wiring, etc. provided under this section of the work shall comply in all respects with all requirements of the Electrical Section of the Specifications.
- F. Identification labels shall be provided for each starter, control device, etc. showing the instruments function. Labels shall be in accordance with the requirements for labels as specified under the Electrical Section of the specifications.

- G. All control wiring shall be provided under this section of the work, unless specifically indicated otherwise under the Electrical Section of the specifications.
- H. Each manufacturer shall certify in writing to the Engineer that the equipment furnished has high efficiency motors as specified hereinbefore. The certification shall state motor HP, motor manufacturer, power factor and efficiency.

END OF SECTION

SECTION 23 05 13

SECTION COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

1.01 GENERAL 1.1 SUMMARY

- A. Section includes single- and three-phase motors for application on equipment provided under other sections.
- B. Related Sections:
 - 1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 2. Section 26 00 00 - Identification for Electrical Systems.

1.02 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- C. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
- C. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Testing Agency: Company specializing in testing products specified in this section with minimum three years documented experience.

1.05 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.

- D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 - PRODUCTS

2.01 PRODUCT REQUIREMENTS FOR MOTORS FURNISHED WITH EQUIPMENT

- A. Manufacturers: Equal to Eaton Corporation.
- B. Motors 3/4 hp and Larger: Three-phase motor as specified below.
- C. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp may be equipment manufacturer's standard.
- D. Three-Phase Motors: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
 - 1. Voltage: As indicated on Drawings.
 - 2. Service Factor: 1.25As indicated on Drawings.
 - 3. Enclosure: Meet conditions of installation unless specific enclosure is indicated on Drawings.
 - 4. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 5. Insulation System: NEMA Class F.
 - 6. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 7. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
 - 8. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
 - 9. Sound Power Levels: Conform to NEMA MG 1.
- E. Single Phase Motors:
 - 1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
 - 2. Voltage: As indicated on the drawings.
- F. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.02 SOURCE QUALITY CONTROL

- A. A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 - EXECUTION

3.01 EXISTING WORK

- A. Disconnect and remove abandoned motors
- B. Maintain access to existing motors and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing motors to remain or are to be reinstalled

3.02 INSTALLATION

- A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- B. Install engraved plastic nameplates in accordance with Section 26 00 00.
- C. Ground and bond motors in accordance with Section 26 05 26

3.03 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL 1.1 SUMMARY

- A. Section Includes: 1. Vibration isolators.
- B. Related Sections:
 - 1. Section 07 90 00 - Joint Protection: Product requirements for joint sealers specified for placement by this section.
 - 2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
 - 3. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this section.
 - 4. Section 23 33 00 - Air Duct Accessories: Product requirements for both solid and flexible duct connectors for duct silencers specified for placement by this section.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- B. American National Standards Institute:
 - 1. ANSI S1.4 - Sound Level Meters.
 - 2. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 - 3. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
 - 4. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
- C. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
- D. American Society of Heating, Refrigerating and:
 - 1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 - 2. ASHRAE Handbook - HVAC Applications.
- E. ASTM International:
 - 1. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

2. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
3. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

F. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.03 PERFORMANCE REQUIREMENTS

- A. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping and ductwork.
- B. Provide minimum static deflection of isolators for equipment as follows: 1. At grade, Under 20 hp
 1. Under 400 rpm: 1 inch
 2. 400 - 600 rpm: 1 inch
 3. 600 - 800 rpm: 0.5 inch
 4. 800 - 900 rpm: 0.2 inch
 5. 1100 - 1500 rpm: 0.14 inch
 6. Over 1500 rpm: 0.1 inch
- C. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.
- C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.
- E. Test Reports: Indicate dynamic insertion loss and noise generation values of silencers.
- F. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- G. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- H. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with AMCA 300 standards and recommendations of ASHRAE 68.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Open Spring Isolators:

- 1. Spring Isolators:

- a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
- 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- 3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.

- B. B. Restrained Spring Isolators:

- 1. Spring Isolators:

- a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
- 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
- 3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
- 4. Restraint: Furnish mounting frame and limit stops.

- C. Closed Spring Isolators:

1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
- D. Restrained Closed Spring Isolators:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
- E. Spring Hanger:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators rubber hanger with threaded insert.
 4. Misalignment: Capable of 20 degree hanger rod misalignment.
- F. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.
- G. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.
- H. Seismic Snubbers:

1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
2. Neoprene Elements: Replaceable, minimum of 0.75 inch thick.
3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify equipment, ductwork and piping is installed before work in this section is started

3.02 EXISTING WORK

- A. Provide access to existing piping and ductwork and other installations remaining active and requiring access.
- B. Extend existing piping and ductwork installations using materials and methods compatible with existing electrical installations.

3.03 INSTALLATION

- A. A. Install isolation for motor driven equipment.
- B. B. Bases:
 1. Set steel bases for 1 inch clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 2 inch clearance between housekeeping pad and base.
- C. C. Adjust equipment level.
- D. D. Install spring hangers without binding.
- E. E. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- F. F. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

3.04 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect isolated equipment after installation and submit report. Include static deflections.
- C. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and

other critical locations. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

- D. Furnish services of testing agency to take noise measurement. Use meters meeting requirements of ANSI S1.4.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Nameplates.
2. Tags.
3. Labels.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Samples: Submit two tags, labels, pipe markers, size used on project.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers. 1.5

1.05 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories. 1.6

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.07 PRE-INSTALLATION MEETINGS

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.01 NAMEPLATES

A. Manufacturers:

1. Equal to Craftmark Identification Systems

B. Product Description: Laminated three-layer plastic with engraved white letters on black background color.

2.02 TAGS

A. Plastic Tags:

1. Manufacturers:

- a. Equal to Craftmark Identification Systems.

2. Laminated three-layer plastic with engraved white letters on black background color. Tag size minimum 1-1/2 inches diameter.

B. Metal Tags:

1. Manufacturers:

- a. Equal to Craftmark Identification Systems.

2. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges.

C. Information Tags:

1. Manufacturers:

- a. Equal to Craftmark Identification Systems

2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5- 5/8 inches with grommet and self-locking nylon ties.

D. Tag Chart: Typewritten letter size list of applied tags and location plastic laminated.

2.03 LABELS

A. Manufacturers:

1. Equal to Craftmark Identification Systems

B. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Install tags using corrosion resistant chain. Number tags consecutively by location.
- E. Identify fan units with plastic nameplates. Identify in-line pumps and other small devices with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Tag automatic controls, instruments, and relays. Key to control schematic.
- H. Identify ductwork with plastic nameplates. Identify with fan unit identification number and area served.

END OF SECTION

SECTION 23 05 94

TESTING, ADJUSTING, AND BALANCING FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Testing, adjusting and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.
3. Vibration measurement of equipment operating conditions.

1.02 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau:

1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.03 SUBMITTALS

- A. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- B. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms
- C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports in soft cover, letter size, binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of flow measuring stations, balancing valves and rough setting.
- B. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. Prior to commencing Work, calibrate each instrument to be used.

1.06 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years experience certified by AABC .
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer.

1.07 SEQUENCING

- A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Service and balancing valves are open.

3.02 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Engineer to facilitate spot checks during testing.

3.03 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design

3.04 ADJUSTING

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- G. Check and adjust systems approximately six months after final acceptance and submit report.

3.05 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near occupied area entry.

3.06 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

- 1. Packaged Outside Air Conditioning Units.
- 2. Air Inlets and Outlets.
- 3. Ductless Split System Heat Pumps and Air Conditioners.
- 4. Split System Air Conditioning Units
- 5. Makeup Air Units
- 6. Air Handling Units
- 7. Supply and Exhaust Fans
- 8. Heat Pumps

B. Report Forms

- 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location

- f. Project Engineer
 - g. Project Contractor
 - h. Project altitude
 - i. Report date
- 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
- 3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
- 4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location

- b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
6. Cooling Coil Data:
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Saturated suction temperature, design and actual
 - k. Air pressure drop, design and actual
7. Air Moving Equipment:
- a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure

- l. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM
- 8. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air ratio
 - m. Actual outside/return air ratio
- 9. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
- 10. Duct Leak Test:

- a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 - 1) Blower
 - 2) Orifice, tube size
 - 3) Orifice size
 - 4) Calibrated
 - g. Test static pressure
 - h. Test orifice differential pressure
 - i. Leakage
11. Air Distribution Test Sheet:
- a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow
12. Vibration Test:
- a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (when applicable)

- 4) Motor bearing, drive end
- 5) Motor bearing, opposite end
- 6) Casing (bottom or top)
- 7) Casing (side)
- 8) Duct after flexible connection (discharge)
- 9) Duct after flexible connection (suction)
- b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
- c. Normally acceptable readings, velocity and acceleration
- d. Unusual conditions at time of test
- e. Vibration source (when non-complying)

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. HVAC ductwork insulation, jackets, and accessories for supply, return, exhaust and outside air ductwork inside and outside buildings.
2. Condensate drain line insulation.
3. Refrigerant piping insulation.

1.02 SUBMITTALS

- A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.03 QUALITY ASSURANCE

- A. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.06 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.07 WARRANTY

- A. Furnish one year manufacturer warranty for man-made fiber.

PART 2 - PRODUCTS

2.01 REFRIGERANT LINE INSULATION

- A. Flexible foamed pipe insulation. Foam rubber insulation shall have a maximum k factor of .27 and shall have an operating temperature range of -40 degrees F to 220 degrees F. Insulation shall comply with ASTM C-534 and UL 94-5v. Insulation shall be rated for use in return air plenum and shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less. Insulation as installed shall meet the minimum requirements of the current edition of the International Energy Conservation Code.
- B. Thickness:
 - 1. 1" thick for 1-1/2" outside diameter and smaller pipe.
 - 2. 1-1/2" thick for pipes larger than 1-1/2" outside diameter pipe.
- C. Approved Manufacturers: Armaflex, Rubatex, GSG " Ultrafoam", Halstead "Insul-tube", Manville Aerotube II, Imcolock, or Imcoaflex. Approved adhesives are Armaflex 520, Manville Micro-Lok 650, BFG Construction adhesive #105, Imcoa fuse seal joining system, or Imcoa Leaktite.

2.02 AIR CONDITIONING CONDENSATE DRAIN LINES

- A. Insulate condensate lines with 3/4" foamed rubber pipe insulation. Foam rubber insulation shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as tested by ASTM E 84-75. Insulation shall have a 0.29 maximum K factor (BTU-in.)/(h-ft³-°F) at 75 degrees F mean temperature. Seal all seams and joints with adhesive equal to Armstrong 520.
- B. Insulation shall be Armaflex "AP", or equal product by Rubatex, or Manville.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install all insulation in strict accordance with the manufacturer's recommendations, using approved type laggings, adhesives, mastics, and other materials as applicable.

3.02 REFRIGERANT PIPING

- A. Insulation shall fit in snug contact with pipe and be installed in accordance with manufacturer's recommendations.
- B. Stagger joints on layered insulation.
- C. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
- D. Seal joints in insulation with Manufacturer's approved adhesive.
- E. Provide six inch long, 20 gauge galvanized steel sleeve around pipe insulation at each support.
- F. Extend insulation through pipe support clamps.

- G. Insulation exposed outside building shall have any required slit joints and seams placed on bottom of pipe and given two coats of gray adhesive finish.
- H. Insulate fittings with sheet insulation and as recommended by Manufacturer.
- I. Paint exterior exposed insulation with two coats of gray finish recommended by Insulation Manufacturer, then finish with a .016" thick aluminum jacket secured with stainless steel bands.
- J. Underground refrigerant lines shall be run in rigid PVC conduit. Each line shall be run in a separate conduit of sufficient size to accommodate pipe and insulation. Where conduit penetrates exterior wall and interior floor slab, it shall be sealed with a waterproof mastic.

3.03 CONDENSATE DRAIN LINES

- A. Seal all seams and joints with adhesive.
- B. Where possible, slip insulation on piping without splitting.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Control panel enclosures.
2. Thermostats.
3. Electric damper actuators.
4. Direct digital control system components.
5. Duct-mounted smoke detector.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for electric motors.
2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
3. Section 23 33 00 - Air Duct Accessories: Product requirements for duct mounted thermometers. Installation requirements for dampers and other duct mounted products furnished in this section.

1.02 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.

C. American Society of Mechanical Engineers:

1. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

D. ASTM International:

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B32 - Standard Specification for Solder Metal.
 4. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 5. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 6. ASTM D2737 - Standard Specification for Polyethylene (PE) Plastic Tubing.
- E. American Welding Society:
1. 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- F. National Electrical Manufacturers Association:
1. NEMA DC 3 - Residential Controls - Electrical Wall Mounted Room Thermostats.
 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. National Fire Protection Association:
1. NFPA 72 - National Fire Alarm Code.
 2. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
- H. Underwriters Laboratories, Inc.:
1. 1. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics.
- 1.03 SUBMITTALS
- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
 - B. Shop Drawings: Indicate operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Coordinate submittals with information requested in Section 23 09 93.
 - C. Product Data: Submit description and engineering data for each control system component. Include sizing as required.
 - D. Manufacturer's Installation Instructions: Submit installation requirements for each control component.
 - E. Manufacturer's Certificate: Certify products meet or exceed specified requirements
- 1.04 CLOSEOUT SUBMITTALS
- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
 - B. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.
 - C. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

- B. Accept controls on site in original factory packaging inspect for damage.

1.06 COORDINATION

- A. A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. B. Coordinate installation of control components in duct systems with work of Section 23 33 00.

1.07 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for each control system component.

1.08 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.
- B. Furnish service and maintenance of control system for one year from completion of project as a whole.
- C. Furnish complete service of controls systems, including callbacks. Perform minimum of two complete inspections of approximately 4 hours duration, one in each season, in addition to normal service calls to inspect, calibrate, and adjust controls. Submit written report after each inspection.
- D. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- E. Perform work without removing units from service during building normal occupied hours.
- F. Provide emergency call back service for this maintenance period.
- G. Maintain an adequate stock of parts for replacement or emergency purposes. Ensure personnel availability to ensure fulfillment of this maintenance service without unreasonable loss of time.
- H. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.
- I. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

PART 2 - PRODUCTS

2.01 CONTROL COMPONENT MANUFACTURERS

- A. Manufacturers:
 - 1. Honeywell, Building Control Solutions.
 - 2. Johnson Controls, Inc.
 - 3. Siemens Building Technologies, Inc.
 - 4. Schneider Electric.

2.02 CONTROL PANEL ENCLOSURES

- A. Furnish for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face.
- B. Construction: NEMA 4, steel enclosure.
- C. Covers: Continuous hinge, held closed by flush latch operable by screwdriver.
- D. Enclosure Finish: Manufacturer's standard enamel

2.03 THERMOSTATS

- A. Electric Room Thermostats:
 - 1. Type: NEMA 3R, 24 volts.
 - 2. Service: Cooling and/or heating in accordance with the application.
 - 3. Covers: Open set point adjustment, setpoint indication and thermometer.
- B. Room Thermostat Accessories:
 - 1. Thermostat Covers: Painted steel.
 - 2. Insulating Bases: For thermostats located on exterior walls.
- C. Air-stream Thermostats:
 - 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 - 2. Averaging service remote bulb element: 12 feet.
 - 3. Furnish with flange and shield.

2.04 ELECTRIC DAMPER ACTUATORS

- A. Fully factory assembled. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under every condition.
- B. Motor: Permanent split-capacitor or shaded-pole type. Gear trains completely oil immersed and sealed. Furnish spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
- C. Actuator: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. Furnish actuator with rating of not less than twice thrust needed for actual operation of valve.
 - 1. Coupling: V-bolt and V-shaped, toothed cradle.
 - 2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 3. Fail-Safe Operation: Mechanical, spring-return mechanism. Furnish external, manual gear release on non-spring-return actuators.

4. Furnish spring-return actuators with manual override. Complete manual override to take no more than 10 turns.
5. Power Requirements:
 - a. Two-Position Spring Return: 24 volt AC or DC, maximum 10 vA.
 - b. Modulating: 24 volt AC, maximum 15 vA.
6. Proportional Signal: 2 to 10 volt dc or 4 to 20 mA, and 2 to 10 volt dc position feedback signal.
7. Temperature Rating: minus 22 to 140 degrees F.
8. Run Time: 200 seconds open, 40 seconds closed.

D. Size for torque required for damper close-off at maximum differential pressure.

2.05 DIRECT DIGITAL CONTROL SYSTEM COMPONENTS

A. A. Temperature Sensors:

1. 1. Type: Resistance temperature detector (RTD) or thermistor.
2. 2. Accuracy:
 - a. Plus or minus 1 degree F for standard applications. Where high accuracy is required, furnish accuracy of plus or minus 0.2 degrees F.
 - b. Sensing Accuracy: Plus or minus 0.5 degree F.
 - c. Display Accuracy and Resolution: Minimum of plus or minus 1 degree F.
3. Built-in communications port.
4. Space Sensors: Digital with LCD display, day-night override button, and set point slide adjustment override options. Set point slide adjustment capable of being software limited by automation system to limit amount of room adjustment.
5. Outside Air Sensors: Watertight inlet fitting, furnish with shield from direct sunlight.
6. Duct Temperature Sensors:
 - a. Rigid or averaging type as indicated in sequence of operations. Averaging sensor minimum length: 5 feet in length.
 - b. Duct Cross Sections Greater Than 10 square feet: Furnish serpentine averaging element to sense stratified air temperatures.
7. Piping Temperature Sensors: Furnish with separable brass well.

2.06 DUCT-MOUNTED SMOKE DETECTOR

A. Product Description: NFPA 72, photoelectric type with the following features:

1. Auxiliary SPDT relay contact.
2. Key-operated normal-reset-test switch.

- a. Duct sampling tubes extending width of duct.
- 3. Visual indication of detector actuation.
- 4. Duct-mounted housing.
- B. Furnish four-wire detector with separate power supply and signal circuits.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify air handling units and ductwork installation is complete and air filters are in place before installing sensors in air streams.
- C. Verify location of thermostats and other exposed control sensors with Drawings before installation.
- D. Verify building systems to be controlled are ready to operate.

3.02 INSTALLATION

- A. Install control panels adjacent to associated equipment on vibration free walls or freestanding supports. Use one cabinet for each system. Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face. Label with appropriate equipment or system designation.
- B. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- C. Install conduit and electrical wiring in accordance with Section 23 05 00

3.03 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.04 DEMONSTRATION AND TRAINING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate complete and operating system to Owner. END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.01 SPECIAL NOTE

- A. Piping shown on drawings shall be installed complete and shall be of the size shown. When a size is not indicated, the Mechanical Contractor shall request the pipe size from the Engineer through the General Contractor. All piping shall be installed parallel or perpendicular to the building construction.
- B. Some refrigerant line lengths and/or vertical lifts may exceed manufacturer's recommendations. Mechanical contractor is responsible for insuring the equipment manufacturer sizes all refrigerant lines for these pieces of equipment. Provide suction line accumulators and solenoid valves near the expansion valve if necessary.

PART 2 - PRODUCTS

2.01 REFRIGERANT PIPING

- A. All refrigerant piping shall be type "L-ACR " copper tubing, hard drawn with wrought copper solder type fittings suitable for connection with silver solder.
- B. Refrigerant suction piping shall be trapped at each indoor unit. Each liquid line shall be provided with a dryer as specified in the Equipment section of these specifications. Provide all necessary valves to isolate dryer to allow service without losing entire system charge.

PART 3 - EXECUTION

3.01 REFRIGERANT PIPING JOINTS

- A. All joints in piping shall be silver soldered. The piping shall be charged with dry nitrogen while constructing the joints. Piping within chases in building shall be one piece, no joints will be allowed in hidden or inaccessible areas.

3.02 PRESSURE TESTING

- A. All refrigerant piping shall be tested in accordance with equipment manufacturer's recommendations and in compliance with Section 232300.

3.03 PIPE HANGERS AND SUPPORTS

- A. The contractor shall furnish all labor, materials, equipment and incidentals and install pipe hangers, supports, concrete inserts, and anchor bolts including all metallic hanging and supporting devices for supporting exposed piping.

- B. Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for pipe supports shall be five (5) times the ultimate strength of the support. All pipe and appurtenances connected to equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the contractor shall submit a certification stating that such requirements have been complied with.
- C. Submit to the Engineer for approval shop drawings of all items to be furnished under this section.
- D. Submit to the Engineer samples of all materials specified herein if requested. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe and personnel contact.
- E. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58.
- F. Hangers and supports shall be spaced in accordance with MSS SP-69 Table 3.
- G. Pipe hangers and supports shall be as manufactured by B-Line Systems, Inc. or equal by PHD, Grinnell, or Fee and Mason. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product shall not be considered as proprietary. Any item comparable in type, style, quality, design and performance will be considered for approval.
- H. Hanger rods, nuts, and bolts shall be galvanized steel.
- I. All supports shall be galvanized construction.
- J. Pipe Hangers and Supports for Refrigerant piping shall be equal to B-Line galvanized steel strut system.
 - 1. All hangers and supports shall have some form of adjustment available after installation. Hanger material shall be compatible with the pipe material.
 - 2. Hangers for copper tubing shall be B-Line Systems, Inc. Strut system with Vibra Cushion isolators and pipe clamps.
 - 3. Piping hangers shall be installed around the outside of the insulation with protective shields.
- K. Hanger Rods:
 - 1. Hanger rods shall be B-Line Systems, Inc. figures B3205 and ATR or equal.
 - 2. Hanger rods shall be subjected to tension only. Lateral and axial movement shall be accommodated by proper linkage in the rod assemble.
 - 3. Hanger rod diameters shall be based on MSS SP-69 Table 4.
- L. Concrete Inserts:
 - 1. Concrete inserts for pipe hangers shall be continuous metal inserts designed to be used in ceilings, walls, or floors, spot inserts for individual pipe hangers and shall be as manufactured by B-Line Systems, Inc. or equal and shall be as follows:

- a. Continuous concrete inserts shall be used where applicable and shall be used for hanger rod sizes up to and including 3/4" diameter. Inserts to be used where supports are parallel to the main slab reinforcement shall be B221, B321, or B521 by B-Line Systems, Inc. or equal.
- b. Spot concrete inserts shall be used where applicable and shall be used for hanger sizes up to and including 7/8" diameter. Inserts shall be figures B2505 thru B2508, B2500, or B3014 by B-Line Systems, Inc. or equal.

M. Riser Clamps:

1. Riser piping shall be supported independently of any connected horizontal piping if possible. Provide supplementary steel or concrete supports for clamps. The clamps shall not be supported by the sleeves.
2. Support all vertical runs of ambient piping at each floor or as specified with B-Line Systems, Inc. figures B3373, B3131, B3373CT as required or equal.

N. Saddles:

1. Pipe covering protection saddles shall be used in conjunction with all insulated cold pipe lines. All saddles shall be centered on the piping and in the hangers.
2. Saddles for all insulated piping shall be galvanized sheet metal saddle shields of adequate size to cover the bottom 120 degrees of the pipe insulation. The shields shall be properly curved to evenly contact the outside circumference of the insulation and shall have rounded corners (1/2" radius). The length of the shields shall be as recommended by the pipe insulation manufacturer for the pipe size, insulation thickness and hanger spacing, but in shields shall be constructed of sheet metal of gauges not less than that listed below:

<u>Pipe Size</u>	<u>Min. Gauge</u>	<u>Min. Length</u>
Up thru 3"	18 gauge	12" long
3-1/2 thru 5"	16 gauge	16" long
6" and 8"	14 gauge	20" long
10" and 12"	12 gauge	24" long

3.04 PIPING

- A. shall be installed and connected to the equipment essentially as indicated on the drawings, in a neat and workmanlike manner. Unless specifically noted otherwise, all piping shall be concealed above ceilings and inside walls where possible.
- B. ALL PIPING and equipment shall be supported by the building structure. Unless specifically noted otherwise, no piping or equipment shall be supported from ductwork, other piping, plenum construction or other equipment.
- C. ALL PIPING shall be installed and arranged to allow free movement to the piping due to expansion, contraction, building movement, etc. without putting excessive stress or strain into the piping or equipment. All piping, risers, runouts, etc. subject to deflection by expansion and contraction shall be cold-sprung 50% of the deflection required to be absorbed. All sleeves and other openings in the

construction shall be of sufficient size and spaced so as to allow for the necessary pipe movement without undue stress on piping. Risers shall be free to travel as required with the horizontal piping. Piping runouts to and from risers shall be absorbed and still maintain the specified pitch for the runouts and piping to and from the risers.

- D. PIPING and equipment suspended from steel construction shall be suspended from beams or from the panel points of the bar joist only. When the hanger point is not directly below a structural member or a joist panel point, supplementary supporting steel shall be provided across the structural members or bridge joists as required to receive the hanger. The hangers and supporting steel shall not be attached to the roof deck construction.
- E. ALL VERTICAL PIPING shall be installed plum and true. Horizontal piping specified to be graded shall be installed at a straight and uniform grade without pockets. Horizontal piping not specified to be graded, shall be installed in a straight and true manner.
- F. All piping suspended from structure, where the distance from the top of the duct or equipment to the bottom of the structure is more than six (6) inches, shall be provided with seismic cable restraints as detailed in Vibration Mounting and Control, Inc. Drawing # 33557 or 33558 as appropriate. Cabling system shall be sized and installed in strict accordance with manufacturer's recommendations for compliance with Standard Building Code Section 1206.
- G. ALL PIPING SYSTEMS shall be arranged to drain to one or more low points. Each low point shall be equipped with a hose and valve drain connection.

3.05 UNIONS AND/OR COMPANION FLANGES SHALL BE PROVIDED AT ALL EQUIPMENT CONNECTIONS AND ELSEWHERE AS INDICATED ON THE DRAWINGS OR AS REQUIRED FOR EASY REMOVAL OF EQUIPMENT.

3.06 INSULATION

- A. Insulate refrigerant piping as specified in section 230700 of these specifications.

END OF SECTION

SECTION 23 30 00

AIR DISTRIBUTION

PART 1 - GENERAL (NOT USED)

PART 2 - PRODUCTS

2.01 SUPPLY DIFFUSERS AND RETURN GRILLES

- A. Material and Finishes: Construct diffusers, registers, and grilles of aluminum or stainless steel as indicated on drawing schedules. No steel construction will be allowed on this project. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Diffusers and grilles located in fire rated ceilings shall be steel construction. Colors shall be as specified on schedules or as approved by Owner.
- B. Sound Pressure Level: The inlets and outlets shall be sound rated and certified in accordance with ADC 1062 R4, in db of noise criterion (NC) based on sound power level minus 10 db in each octave band. All devices shall have a sound power level no greater than 35.
- C. Throw: Defined as distance from the diffuser, register, or grille to the point which the air velocity falls below 50 feet per minute. Throw shall not exceed 1.5 times the outlet mounting height.
- D. Drop: Maximum drop of air stream shall not be so great that it is within 6 feet of the floor at the end of the throw.
- E. Air distribution devices shall be by Titus as indicated on grille and diffuser schedule, or approved equals.

2.02 DUCTWORK

- A. Duct to be air tight, smooth on inside and neatly finished on the outside. Details on
- B. construction and materials not specified herein shall be in accordance with recommendations of latest ASHRAE Guide, or Duct Manual published by Sheet Metal and Air Conditioning Contractors National Association, and shall comply with the International Building Code.
- C. Drawings show general arrangement of ducts, but do not necessarily show all offsets, etc., required to avoid interferences. Where shape of duct is varied, alter dimensions to provide equal static pressure drop per unit of length.
- D. Turning vanes must be installed in all square elbows. Radius elbows are to have a centerline radius of 2-1/2 diameters for round duct. Radius elbows in rectangular duct are to have a centerline radius of two duct widths.
- E. Provide splitter dampers for adjustment of distribution to branches where indicated on drawings and elsewhere as required to properly balance system. Splitters shall be the same thickness Aluminum as duct where used but in no case shall the splitter be less than 22 gauge. Splitter shall be hinged at leaving edge and shall have a rounded nose at air entering edge. Length of splitter shall be at least 1-1/2 times the width of smaller branch duct but in no case less than 12". Splitter shall have a 3/8" steel rod hinged to air entering edge and passing through a suitable clamp on the side of duct to permit position

adjustment and rigid anchor in final position. Where size of splitter dictates multiple anchors shall be used.

F. Except as specified, all rectangular ductwork shall be Aluminum fabricated in accordance with latest SMACNA Duct Manual for low pressure ductwork.

G. All ductwork shall be constructed of Aluminum.

2.03 MANUAL DAMPERS

A. Volume control dampers in ductwork shall be Ruskin No. MD-35, or equal opposed blade type, Aluminum, with heavy duty locking quadrant. Equal products by National Controlled Air, Air Control Products, Louvers and Dampers, Inc., Safe-Aire, Air Balance, Inc., or approved equals.

END OF SECTION

SECTION 23 31 00

HVAC DUCTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Duct Materials.
2. Ductwork fabrication.

1.02 PERFORMANCE REQUIREMENTS

- ###### A.
- Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.03 SUBMITTALS

- ###### A.
- Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 3/8 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Fittings.
3. Reinforcing details and spacing.
4. Seam and joint construction details.
5. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
6. Product Data: Submit data for duct materials and flexible connectors.

1.04 CLOSEOUT SUBMITTALS

- ###### A.
- Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.05 QUALITY ASSURANCE

- ###### A.
- Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- ###### B.
- Construct ductwork to NFPA 90A and NFPA 96 standards.

1.06 QUALIFICATIONS

- A. A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. A. Convene minimum one week prior to commencing work of this section.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 WARRANTY

- A. Furnish one year manufacturer warranty for ducts.

PART 2 - PRODUCTS

2.01 DUCT MATERIAL

- A. Aluminum Ducts: ASTM B209 aluminum sheets, 3003H – 14 alloy. Aluminum connectors and bar stock, alloy 6061-T6 or of equivalent strength.
- B. Fasteners: sheet metal screws.
- C. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible Round Duct Construction Standards. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

- G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.
 - 1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 - 2. Do not provide sealing products not bearing UL approval markings.

2.03 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible Round Duct Construction Standards. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems.
 - 1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 - 2. Do not provide sealing products not bearing UL approval markings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify sizes of equipment connections before fabricating transitions.

3.02 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

- C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.
- D. Use double nuts and lock washers on threaded rod supports.
- E. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- F. Exhaust Outlet Locations:
 - 1. Minimum Distance from Building Openings: 3 feet.
 - 2. Minimum Distance from Outside Air Intakes: 10 feet.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.

3.04 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.05 TESTING

- A. For ductwork designed for 3 inches w.c. above ambient, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed. 1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual.

3.06 SCHEDULES

- A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply and return	Aluminum
General Exhaust	Aluminum

- B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Ventilation Air Supply	3 inch wg
General Exhaust	3 inch wg

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Duct access doors.
2. Volume control dampers.

1.02 REFERENCES

A. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 92A - Recommended Practice for Smoke-Control Systems.

B. Sheet Metal and Air Conditioning Contractors:

1. 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories Inc.:

1. UL 555 - Standard for Safety for Fire Dampers.

1.03 SUBMITTALS

- A. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers and duct access doors.
- B. Product Data: Submit data for shop fabricated assemblies and hardware used.
- C. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 1. Volume control dampers.
 2. Duct access doors.

1.04 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of access doors

1.05 .QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.
- B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.
- C. Storage: Store materials in a dry area indoor, protected from damage.
- D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 COORDINATION

- A. Coordinate Work where appropriate with building control Work.

1.10 WARRANTY

- A. Furnish one year manufacturer warranty for duct accessories.

PART 2 - PRODUCTS

2.01 DUCT ACCESS DOORS

- A. Manufacturers: 1. Equal to Ruskin
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Fabrication: Rigid and close fitting of Aluminum with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches [with outside and inside handles].
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.2 VOLUME CONTROL DAMPERS

- D. Manufacturers: 1. Equal to Ruskin.
- E. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- F. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.
- G. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single blade dampers.
 - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify ducts and equipment installations are ready for accessories.
- B. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.02 INSTALLATION.

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access and as indicated on Drawings. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Louvers

1.02 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers: 1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.
- B. Air Movement and Control Association International, Inc.: 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

1.03 SUBMITTALS

- A. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level. Submit color palette for color selection by Engineer with submittal.
- B. Manufacturer's Certificate: Certify products meet or exceed specified requirements

1.04 CLOSEOUT SUBMITTALS

- A. A. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALIFICATIONS

- A. A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.

1.06 WARRANTY

- A. A. Furnish one year manufacturer warranty for air outlets and inlets.

PART 2 - 2 PRODUCTS

2.01 LOUVERS

- A. Manufacturers: Equal to Greenheck.
- B. Product Description: Combination drainable louver with motor operator.
- C. Type: 6 inch deep with blades on 45 degree slope, heavy channel frame.

- D. Fabrication: 0.081-inch thick extruded aluminum blades, with 0.125-inch thick frame.
- E. Mounting: Furnish with exterior flat flange with screw holes in jambs for installation.
- F. Bird Screen: Bird screen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.

PART 3 - EXECUTION 3.1 EXAMINATION

- A. Verify inlet and outlet locations.
- B. Verify ceiling and/or wall systems are ready for installation 3.2 INSTALLATION
 - 1. A. Install louver with wall sleeve.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Check location of louvers and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

SECTION 23 74 13

AIR CONDITIONING/AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. CONTRACTOR SUPPLIED EQUIPMENT Contractor supplied/Contractor installed.
 - a. The Contractor shall supply the following equipment:
 - 1) Air conditioning/air handling units with the following components and accessories:
 - a) Direct-expansion cooling.
 - b) Electric-heating coils.
 - c) Integral, space temperature controls.
 - 2) Split system cooling and heat pump units.
 - b. Comply with requirements in Division 00 Section "General Conditions."
 - 1) Contractor supplied items:
 - a) Fasteners and other items not provided by Owner necessary for a complete installation.

1.02 SUBMITTALS

- ###### A. The Contractor shall submit the following for review. The Contractor shall review and stamp submittals as specified in Division 00 Section "General Conditions."
1. Product Data: Manufacturer's technical data for each air conditioning/air-handling unit, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
 2. Shop Drawings: Equipment assemblies and dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - a. Wiring Diagrams: Power, signal, and control wiring.
 3. Installation Manual: Manufacturers complete manual for installation of unit.

1.03 QUALITY ASSURANCE

A. ARI Compliance:

1. ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for air conditioning/air-handling units.
 2. ARI 270 for testing and rating sound performance for air conditioning/air-handling units.
- B. ASHRAE Compliance:
1. ASHRAE 15 for refrigerant system safety.
 2. ASHRAE 33 for methods of testing cooling and heating coils.
 3. ASHRAE/IESNA 90.1 for minimum efficiency of heating and cooling.
- C. NFPA Compliance: NFPA 90A and NFPA 90B.
- D. UL Compliance: UL 1995.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 1.04 WARRANTY
- A. Contractor shall be responsible for handling manufacturer warranty service during the 90 day warranty period. Contractor shall be responsible for following all warranty procedures and notifying Owner of all warranty repairs.

PART 2 - PRODUCTS

2.01 AIR CONDITIONING/AIR-HANDLING UNITS

- A. Provide equipment as called for on the drawings.
1. See Drawings for schedule of equipment.
 2. Energy Management System (EMS) temperature controls are furnished by the contractor.

2.02 COOLING AND HEAT PUMP UNITS

- A. Provide equipment as called for on the drawings.
1. See Drawings for schedule of equipment.

2.03 CONTROLS

- A. Control equipment and sequence of operation are indicated on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install air conditioning/air-handling units and split system cooling and heat pump units in accordance with manufacturer's installation instructions.
 - B. Installation Includes:
 - 1. Provision of crane for placement of equipment, making connections to HVAC controller and initial balancing, filters and racks at time of start up and all filter changes during construction.
 - 2. Wiring including connections to HVAC controller(s), connections to smoke detectors; and testing and balancing.
 - 3. Replacement of missing and/ or damaged materials after acceptance of equipment.
 - 4. Final connection to EMS panel.
 - C. Install condensate drain, minimum connection size, with trap and drain as required by authorities of local jurisdiction.
 - D. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to air conditioning/air-handling units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
 - E. Install return-air duct continuously through roof structure.
 - F. Control Wiring: Electrical installer shall provide control wiring. HVAC installer shall provide final connections.
- 3.02 START UP SERVICE
- A. Provide an experienced service technician for start up. Ensure that all components of the rooftop units are operating properly.
 - 1. Complete and submit the attached RTU/AHU System Test Checklist to the Owner for new roof top and air handling units.
 - 2. Post all RTU/AHU System Test Checklists to the Testing and Inspection folder on the project page in the Owner's Project Management Website.
 - B. Owner will provide a technician for review of and inspection of balancing and will make recommendations to Contractor regarding adjustments for final balancing. Contractor will make final adjustments in response to these recommendations.
 - C. If ambient temperatures prevent compressor testing at initial startup, return to site and complete testing once ambient temps are above 65 degrees F (18.3 degrees C).

PART 4 -

4.01 CLEANING AND ADJUSTING

- A. Clean up work. Touch-up with matching paint all damaged factory finishes.
- B. Fully charge all rooftop equipment with refrigerant and ensure proper oil levels.
- C. Provide new filters on the day building is turned over to Owner for grand opening.

END OF SECTION

SECTION 25 00 00

PROCESS INSTRUMENTATION AND CONTROL SUPPLIER

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. A process instrumentation and control supplier (pics) shall furnish all services and equipment specified herein and in other specification sections as listed in article 1.2 – related work. Sub-suppliers and/or manufacturers may provide components, and/or services to the pics, but the final product shall conform to this specification and shall be the sole responsibility of the pics.
- B. The process instrumentation and control supplier (pics) shall report directly to the general contractor.
- C. The process instrumentation and control supplier (pics) shall be c2i control instruments, inc. (404) 351 - 1085.
- D. All materials, equipment, labor and services required to achieve a fully configured, integrated and operational process control system shall be provided by the pics. The pics shall design and coordinate the process control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications and with related existing equipment.
- E. Pics shall furnish all networking equipment shown on p&ids, including, but not limited to control panels, network switches, sonic wall, printer, him package, computer, monitors, etc.
- F. Application software programming for the programmable logic controllers (plc) and human machine interface (hmi) computers shall be provided by the pics. All programming, configuration and integration, including but not limited to loading of software on computers, operating system software configuration, fiber optic data highway communications between control panels, servers and plcs shall be provided by the pics.
- G. Auxiliary and accessory devices necessary for complete system operation or performance to interface with existing equipment or equipment provided by other suppliers under other sections of these specifications, shall be included whether or not they are shown on the drawings. These devices include but are not limited to, transducers, current isolators, signal conditioners or interposing relays.
- H. Substitution of functions or type of equipment specified shall not be acceptable, but the pics is encouraged to recommend changes in the design that will improve the overall process control system subject to approval by the engineer. In order to ensure interchangeability of parts, maintain quality, interface between other subsystems, and establish minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. System design shall allow removing devices from service without disrupting other devices in the process control system.
- I. Equipment shall be fabricated, assembled, installed and placed in proper operating conditions in full conformity with detail drawings, specifications, engineering data, instructions and recommendations by the equipment manufacturers as approved by the Engineer.
- J. To facilitate the Owner's future operation and maintenance efforts, similar products shall be by the same manufacturer, as much as possible.
- K. All equipment and installations shall be in accordance with Federal, State and Local codes, regulations and laws.

- L. Where applicable, the PICS shall coordinate with other suppliers under other sections of these specifications on the following:
 - 1. Interface requirements.
 - 2. PLC input and output (I/O) requirements.
 - 3. Consistency of instrumentation.
 - 4. PLC communication requirements.
 - 5. Transfer of data.
 - 6. HMI graphic screen design.
 - 7. Control requirements.
- M. All materials, equipment, labor and services necessary to achieve the monitoring, control and reporting functions described herein shall be provided in a timely manner so that the monitoring, control and reporting functions are available when the equipment or process is ready to be placed in service.
- N. The PICS shall coordinate, and schedule all required testing and training with the General Contractor, Engineer and Owner in a timely manner.
- O. The PICS shall submit a monthly status report and updated project schedule to the General Contractor so that the General Contractor can integrate the PICS work into the overall project schedule.

1.02 RELATED WORK

- A. The PICS shall furnish all materials, labor and services specified in Division 25 and the drawings, as required to ensure a complete coordinated process control system. Division 25 specifications include:
 - 1. Section 25 00 10 – Application Engineering Services
 - 2. Section 25 00 20 – Panels
- B. The PICS shall coordinate with all equipment suppliers, subcontractors including mechanical and electrical and the General Contractor.

1.03 SUBMITTALS

- A. Submittals shall fully demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and provide a true and complete record of the equipment as manufactured and delivered. Each submittal shall be securely bound with an index and sectional dividers. All submittal drawings shall be legible and a maximum size of 11-inches by 17-inches.
- B. The Engineer shall determine whether a product is an “Approved Equal” based upon the information specified herein and the manufacturer’s data sheets regarding the models specified. Substitute or alternate equipment must meet the criteria listed herein and any additional information in the manufacturer’s data sheets in order to be accepted as an “Approved Equal”. The supplier must furnish at the Engineer’s request five (5) working installation references for any substitute or alternative equipment along with reference Owner, contact and telephone number.
- C. Submittals listed below shall be provided as a minimum. Each submittal must be complete in order to be reviewed by the Engineer. A total of ten (10) submittals of each type is required.
 - 1. Field instruments

2. SCADA system hardware and software
3. Control panels, panel mounted equipment and wiring
4. Instrument loop diagrams
5. Ladder logic for Proportional/Integral Derivative (PID) control
6. Spares and test equipment
7. Operation and maintenance manuals (O&M)
8. As-built documentation
9. Submittal Descriptions.
10. Field Instruments
 - a. This submittal shall provide complete documentation of all field instruments. A complete Bill of Materials (BOM) listing all field instrumentation equipment shall be provided.
 - b. Provide data sheets for each instrument listing model numbers, options and ancillary devices that are being provided. Data sheets shall be provided with an index, proper identification and appropriate cross-referencing. Data sheets shall include, but not be limited to, the following information:
 - 1) ISA instrument tag number
 - 2) Item name used herein and on the Drawings
 - 3) Manufacturer's complete model number
 - 4) Physical installation location
 - 5) Input or output characteristics
 - 6) Range, units, size and graduations
 - 7) Physical dimensions
 - 8) Enclosure dimensions
 - 9) NEMA classification
 - 10) Mounting details
 - 11) Materials of construction
 - 12) Instrument sizing calculations, where applicable
 - 13) Calibration data (Certified for all flow metering devices)
 - c. Provide manufacturer's equipment specifications, which shall fully describe each device, the intended function, how it operates, and its physical environment and performance characteristics. As a minimum, the specification sheets shall include the following:
 - 1) Complete information regarding the instrument.

- 2) Description of operation
 - 3) Performance characteristics
 - 4) Calibration standards
 - 5) Environmental characteristics
 - 6) Electrical requirements
 - 7) Process requirements
 - 8) Materials of construction
 - 9) Physical dimensions and clearance requirements
 - 10) Installation details
 - 11) Maintenance and calibration requirements
 - 12) Spare parts, special tools and test equipment requirements
 - 13) SCADA System Hardware and Software
- d. This submittal shall provide complete documentation of all SCADA system hardware and software. A complete Bill of Materials (BOM) listing all SCADA system hardware and software shall be provided.
 - e. This submittal shall include all computer workstations, servers, printers, and data highway network, network switches, fiber-optic cable, fiber-optic connectors, PLCs, UPSs and related equipment. This submittal shall also include all related software for the SCADA system including the computer operating system, communications network, management, operations, HMI, report, PLC, diagnostic, etc.
 - f. Provide a complete set of SCADA System Block Diagrams showing interconnections between all major components of the SCADA system. The block diagrams shall reflect the total integration of all digital devices in the SCADA system and any human machine interface (HMI) locations. Locations of all components shall be clearly identified with appropriate cross-references. The diagrams shall also show all interconnecting cabling requirements for digital components of the system including the complete data highway network. The diagrams shall include, but not be limited to:
 - 1) Computers and peripheral devices
 - 2) Control centers
 - 3) PLCs
 - 4) Panels and Consoles
 - 5) Data highway
 - 6) Interfaces to other systems
 - g. Provide data sheets for each component of the SCADA system hardware and software listing model numbers, options and ancillary devices that are being provided. Data sheets shall be provided with an index, proper identification and appropriate cross-referencing. Data sheets shall include, but not be limited to, the following information:

- 1) ISA instrument tag number, if applicable
 - 2) Item name used herein and on the Drawings
 - 3) Manufacturer's complete model number
 - 4) Physical installation location
 - 5) Functional characteristics
 - 6) Physical dimensions
 - 7) Enclosure dimensions, if applicable
 - 8) NEMA classification
 - 9) Mounting details
 - 10) Materials of construction
 - 11) UPS sizing calculations
- h. Provide manufacturer's equipment specifications, which shall fully describe each device, the intended function, how it operates, and its physical environment and performance characteristics. As a minimum, the specification sheets shall include the following:
- 1) Complete information regarding the equipment as required by ISA-S5.4 standards.
 - a) Description of operation
 - b) Performance characteristics
 - c) Calibration standards
 - d) Environmental characteristics
 - e) Electrical requirements
 - f) Process requirements
 - g) Materials of construction
 - h) Physical dimensions and clearance requirements
 - i) Installation details
 - j) Maintenance and calibration requirements
 - k) Spare parts, special tools and test equipment requirements
 - 2) Provide a complete SCADA System Input/Output (I/O) List for all equipment connected to the SCADA system under this Contract. The I/O List shall fully identify and describe each I/O point in the SCADA system, the intended function, how it operates, and its physical location and performance characteristics. As a minimum, the I/O List shall include the following:
 - a) I/O Point Address (PLC name, PLC address and point address)

- b) I/O Physical Address (Panel name, rack, slot, etc.)
 - c) I/O Alarms, limits and tag names
 - d) Identify Instruments for 2-wire or 4-wire configuration
 - e) Any other applicable data
- 3) See P&IDs and Electrical Schematic Diagrams on Electrical Drawings for I/O requirements. All I/O on electrical schematic diagrams shall be accounted for even if not shown on P&IDs.
- 4) The submittal shall also contain all planning information, site preparation instructions, power supply and grounding procedures, cabling diagrams, system identification, safety precautions and equipment layouts in order to enable the General Contractor to proceed with detailed site preparation for all equipment.
 - a) Control Panels, Panel Mounted Equipment and Wiring
- 5) This submittal shall provide complete documentation of all control panels, panel mounted equipment and related wiring. A complete Bill of Materials (BOM) listing all panels and panel-mounted equipment shall be provided.
- 6) Provide data sheets for each panel, equipment or instrument listing model numbers, options and ancillary devices that are being provided. Data sheets shall be provided with an index, proper identification and appropriate cross-referencing. Data sheets shall include, but not be limited to, the following information:
- 11. ISA instrument tag number
- 12. Item name used herein and, on the Drawings,
- 13. Manufacturer's complete model number
- 14. Physical installation location
- 15. Input or output characteristics
- 16. Range, units, size and graduations
- 17. Physical dimensions
- 18. Enclosure dimensions
- 19. NEMA classification
- 20. Mounting details
 - a. Materials of construction
 - b. Instrument sizing calculations, where applicable
 - c. Calibration data
 - 1) Provide manufacturer's equipment specifications, which shall fully describe each device, the intended function, how it operates, and its physical environment and performance characteristics. As a minimum, the specification sheets shall include the following:

- a) Complete information regarding the panel, equipment or instrument as required by ISA-S5.4 standards.
 - b) Description of operation
 - c) Performance characteristics
 - d) Calibration standards
 - e) Environmental characteristics
 - f) Electrical requirements
 - g) Process requirements
 - h) Materials of construction
 - i) Physical dimensions and clearance requirements
 - j) Installation details
 - k) Maintenance and calibration requirements
 - l) Spare parts, special tools and test equipment requirements
- 2) Provide detailed drawings for all control panels, PLC panels, consoles, etc. which shall include, as a minimum, the following:
- a) Panel assembly and physical layout drawings to scale. Drawings shall include exterior front and side views, as required to show the physical dimensions of the panel and all exterior mounted equipment. Drawings shall also include interior views of all sub-panels mounted within the enclosure.
 - b) Material and paint specifications.
 - c) Fabrication details.
 - d) Panel wiring diagrams showing all power connections to equipment within and mounted on the panel, panel power requirements, breaker sizes, fuse sizes and grounding requirements. The diagram shall be in ladder logic format and shall cross-reference all appropriate loop drawings for continuation or detail where required. The diagram shall include wire numbers and terminal block designations as required to complete the drawing.
 - e) The submittal shall also contain all planning information, site preparation instructions, power supply and grounding procedures, cabling diagrams, system identification, safety precautions and equipment layouts in order to enable the General Contractor to proceed with detailed site preparation for all equipment.
 - 1. The submittal shall also include power calculations for UPS sizing and heat dissipation calculations for each enclosure.
 - f) Spares, Tools and Test Equipment
 - 1. Provide a comprehensive and complete list of specified and PICS recommended spare parts, tools, expendables and test equipment along with descriptive literature for each of the following sections:

a. Section 250020 – Panels

- g) Provide recommended quantities for each item on each composite list for a period of three years starting when the warranty period begins.
- h) Provide unit pricing for each item on each composite list using the associated manufacturers nationally published list price. Provide copies of all manufacturers' nationally published price lists.
- i) Provide a summary document listing all recommended items, grouped by sections, showing recommended quantities with unit prices and extended item totals, section totals and an overall total.
- j) All spare parts, expendables and test equipment shall be packed in appropriate storage containers for warehouse storage conditions and shall be clearly labeled and identified.
- k) All spare parts shall be delivered to the job site prior to the first startup phase of the project.

1.04 REFERENCE STANDARDS

A. Instrument Society of America (ISA)

- 1. ISA S5.2 – Binary Logic Diagrams for Process Operations
- 2. ISA S5.3 – Graphic Symbols for Distributed Control / Shared Display Instrumentation Logic and Computer Systems
 - a. ISA S5.4 – Instrument Loop Diagrams
 - b. Display Instrumentation Logic and Computer Systems

B. American National Standards Institute (ANSI)

- 1. ANSI X3.5 – Flowchart Symbols and Their Usage in Information Processing

C. National Electrical Manufacturers Association (NEMA)

D. National Electric Code (NEC)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid shall apply.

1.05 PROJECT / SITE REQUIREMENTS

- A. Environmental Requirements. Air-conditioned areas require NEMA Type 1A or 12 ventilated enclosures. Equipment located below grade shall be rated or enclosed for NEMA Type 4X. All other areas require NEMA Type 4X stainless steel enclosures unless otherwise specified. Equipment located outdoors require sun shields.
- B. Elevation. Equipment shall be suitable to operate at a ground elevation of approximately 1000 feet above mean sea level.
- C. Temperature. Equipment mounted indoors shall be suitable to operate from 10 to 35⁰ C ambient. Equipment mounted outdoors shall be suitable to operate from -30 to 50⁰ C ambient. Equipment stored shall be suitable to operate from 0 to 50⁰ C ambient. Additional cooling or heating shall be furnished, if required, for stored equipment.

- D. Relative Humidity. Equipment mounted in air-conditioned areas shall be suitable for 20 to 95 % relative, non-condensing humidity. Equipment mounted in all other areas shall be suitable for 0 to 100 % relative, condensing humidity.
- E. Power Supply. Equipment shall be suitable for 120 VAC electric power supply from unregulated industrial panel boards.

1.06 WARRANTY

- A. Provide warranties per Division 1 requirements and Operation and Maintenance Manuals and as specified herein.

1.07 O & M MANUALS

- A. Prior to final acceptance of the system and owner training, operating and maintenance manuals (O&M) covering instruction and maintenance on each type of equipment shall be furnished.
- B. The manuals shall be bound in three-ring binders with Drawings reduced or folded for inclusion and shall provide the following as a minimum:
 - 1. A comprehensive index.
 - 2. A complete “As Built” set of approved shop drawings.
 - 3. A complete list of equipment supplied, including model numbers, serial numbers, ranges and pertinent data.
 - 4. Detailed service, maintenance and operating instructions for each item.
 - 5. Special maintenance requirements for each specified system clearly defined, along with special calibration and test procedures.
 - 6. Operating instructions and control strategies for each specified system, which incorporate a functional description of the entire system, with references to the shop drawings.
 - 7. A complete parts list with stock numbers, name, address and telephone number of the local supplier.
 - 8. A complete back-up of all PLC program with comment / tag files (as applicable) delivered on a min 1TB external hard drive clearly named and marked WTP PLC programs
 - 9. A complete back-up if the VTSCADA Application delivered on a min 1TB external hard drive clearly named and marked WTP VTSCADA Application Programs.
- C. The final documentation shall be new documentation written specifically for this project but may include standard or modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacently to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.
- D. The manuals shall contain all illustrations, detailed drawings, wiring diagrams and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

- E. If the PICS transmits any documentation or other technical information, which he considers proprietary, such information shall be designated. Documentation or technical information, which is designated as proprietary will be used only for the design, construction, operation or maintenance of the system and, to the extent permitted by law, will not be published or other wise disclosed.
- F. The final documentation requirements are as follows:
1. As-built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory or Field Acceptance Tests shall be incorporated in this documentation.
 2. The Hardware Maintenance documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. Within the complete Hardware Maintenance documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance documentation shall include, as a minimum, the following information:
 - a. Operation Information. This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - b. Preventative Maintenance Instructions. These instructions shall include all applicable visual examinations, hardware testing, diagnostic routines and the adjustments necessary for periodic preventive maintenance of the system.
 - c. Corrective Maintenance Instructions. These instructions shall include guidelines for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source (s) of trouble, the symptoms, probable cause and instructions for remedying the malfunction.
 - d. Parts Information. This information shall include the identification of each replaceable or field-repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between the PICS part number and manufacturer's part number shall be provided.
 - e. System Backup / Restore. This information shall include a detailed description of the procedure for backing up the SCADA system including the computer workstations, servers and PLCs; reloading using a backup; and completely restoring from a backup.

PART 2 - PRODUCTS

2.01 GENERAL

A. Process Control System

1. All equipment and instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals, which are established standards for the water and wastewater industry.

2. All electronic instrumentation shall be of the solid-state type and shall utilize linear transmission signals of 4 to 20 mA DC (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 1 to 5 VDC (volts direct current), or the like.
3. Output of equipment, not of the standard signals as outlined above, shall have the output immediately raised and / or converted to compatible standard signals for remote transmission. Zero based signals shall not be allowed.
4. All instruments shall be provided with mounting hardware, floor stands, wall brackets or instrument racks as shown on the Drawings or as required.
5. Equipment installed in a hazardous area shall meet Class, Group and Division as shown on the Drawings to comply with the National Electric Code.
6. All indicators and recorder readouts shall be linear in process units, unless otherwise noted.
7. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent (2%).
8. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture or fungus. Solid-state components shall be conservatively rated for their purpose to assure optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 95 % relative humidity. Field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
9. All equipment, cabinets, consoles and 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 shall be modular construction and shall be capable of field expansion.
10. Field-mounted digital system equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
11. All electronic and digital equipment shall be provided with radio frequency interference protections and shall be FCC approved.

B. Electrical

1. All equipment shall be designed to operate on a 60-hertz alternating current power source at a nominal 120 volts, +/- 10%, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
3. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

C. SCADA Allowance

1. Contractor shall include an allowance in the amount of **\$30,000** for the design, manufacture and installation of a SCADA System. The SCADA system at the plant is currently functioning properly, this allowance is to make modifications necessary to keep it in operation during construction and to incorporate the Pilot Study into the SCADA system that is included in Contract 2.
2. The allowance shall cover all materials, taxes, freight, and other related fees
3. The cost of equipment required for installation and the Contractor's labor, overhead, and profit shall not be included in the allowance.
4. Any remaining balance, after selection by the Owner, shall be deducted from the Contract amount in the final change order.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The SCADA system, instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms, and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by the Engineer during construction. All information relevant to the placing of SCADA work shall be obtained in the field. In case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- B. The instrumentation loop diagrams indicate the intent of the interconnections between the individual instruments. Any exceptions shall be noted. Two (2) complete sets of approved shop drawings shall be kept at the jobsite during all on-site construction work. Both sets shall be marked up identically to reflect any modifications made during field installation or start-up. All markings shall be verified and initialed by the Engineer or his designated representative.
- C. Following completion of installation, one (1) set of the marked up drawings shall be provided to the Engineer; the other set shall be retained by the PICS for incorporation of the mark-ups into final as-built documentation.
- D. The instrumentation installation details in the Drawings indicate the designed installation for the instrument specified. .
- E. All work shall be executed in full compliance with codes, ordinances, regulations and local rulings. Should any work be performed contrary to said codes, ordinances, regulations or local rulings, the General Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.
- F. All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required on the Drawings for the specific locations.
- G. Unless specifically shown in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifold for calibration, testing and blowdown services shall also be provided. For slurries, chemical or corrosive fluids inline diaphragm seals shall be provided.
- H. All piping to and from field instrumentation shall be provided with necessary unions, test tees, couplings, adaptors and shut-off valves.

- I. Field instruments requiring power supplies shall be provided with local electrical shutoffs and fuses as required by the National Electric Code or as shown on the Drawings.
- J. Brackets and hangars required for equipment mounting shall be provided and shall be installed in a workmanlike manner and shall not interfere with any other equipment.
- K. The PICS shall investigate each space in the building through which equipment must pass to reach its final destination. If necessary, the PICS shall be required to ship material in sections sized to permit passing through restricted areas in the building. The PICS shall also investigate and make any field modifications to the allocated space for each panel, enclosure and console to assure proper space and area around it (front, rear, side).
- L. The shield on each process instrumentation cable shall be continuous from source to destination and shall be grounded as directed by the manufacturer of the instrumentation equipment, but in no case shall more than one ground point be employed for each shield.
- M. Lifting rings shall be removed from panels, enclosures and consoles and the remaining holes plugged using the same color as the panel.
- N. The PICS, acting through the General Contractor, shall coordinate the installation, the placing and location of system components, and their connections to the process equipment panels, cabinets and devices, subject to the Engineer's approval. The PICS shall be responsible for ensuring that all field wiring for power and signal circuits is done correctly in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The General Contractor, hereunder, shall schedule and coordinate his work under this Section with that of the electrical work specified under applicable Sections of Division 16.

3.02 TESTS (GENERAL)

- A. The PICS shall test all equipment at the factory prior to shipment. Unless otherwise specified in the individual specification sections, all equipment provided by the PICS shall be tested at the factory as a single fully integrated system.

3.03 14-DAY SITE ACCEPTANCE TEST (SAT)

- A. The PICS shall be responsible for operation of the entire system for a period of 14 consecutive days, under conditions of full plant process operation, without a single non-field repairable malfunction.
- B. During the test, plant operating and PICS personnel shall be present as required. For this test, the PICS is expected to provide personnel who have intimate knowledge of the system hardware and software.
- C. While the test is proceeding, the Owner shall have full use of the system. Only certified plant operating personnel shall be allowed to operate equipment associated with the actual water production process.
- D. Any malfunction during the tests shall be analyzed and corrected by the PICS. The Engineer/Owner will determine whether any such malfunctions are sufficiently serious to warrant a repeat of this test.
- E. During the 30 consecutive day test period, any malfunction which cannot be corrected within 24 hours of occurrence by PICS personnel, or more than two similar failures of any duration, will be considered a non-field-repairable malfunction.
- F. Upon completion of a non-field-repairable malfunction by the PICS, the test shall be repeated as specified herein.
- G. Down times due to power outages or other factors outside the normal protection devices or back-up power supplies provided shall not contribute to the availability test time above.

- H. Down times due to plant process equipment failures or other factors beyond the control of PICS shall not contribute to the availability test time above.
- I. Upon successful completion of the SAT and subsequent review and approval by the Engineer of the complete system final documentation, the system shall be considered substantially complete, and a one-year warranty period shall commence.

3.04 TRAINING

A. General

- 1. The cost of training programs for the Owner's personnel shall be included in the Contract price. Where practical, the training and instruction shall be directly related to the system being applied.
- 2. Training shall be conducted at the PICS facility or the Owner's facility.
- 3. All Technicians, Operators, Engineers and Managers of the facility shall require training on the system. The training courses shall address operation, maintenance and troubleshooting of the system provided. The courses shall be designed specifically for the type of personnel attending, such as Operators, Engineers, etc.
- 4. All training schedules shall be coordinated with and at the convenience of the Owner. Shift training shall be used where required by the Owner's operations schedule.
- 5. Provide detailed training manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- 6. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to the Owner.
- 7. The Owner reserves the right to videotape all training sessions. All training tapes shall become the sole property of the Owner.

B. HMI Training

- 1. PICS On-Site Training
 - a. The PICS shall provide two sessions of on-site Operator training for the plant operators.
 - b. Session 1 – All Operators (4 hrs)
 - c. Session 2 – Three weeks later – All Operators (4 hrs)
 - d. Operator Training shall focus on the following:
 - 1) Navigating the HMI Screens
 - 2) Event Logging
 - 3) Alarms / Alarm Acknowledging
 - 4) Real Time Data Trending
 - 5) Historical Data Viewing/ Trending
 - 6) Time Stamping

e. The PICS shall provide one day of System Manager Training:

- 1) SCADA system security
- 2) SCADA system backups
- 3) Changing control parameters and set points

C. Field Training

1. Field and Panel Instruments
2. Provide training course for two (2) of Owner's personnel in the operation, configuration, programming, installation and maintenance of the field and panel-mounted instrumentation system supplied.
3. Training shall consist of classroom and hands-on instruction utilizing the Owner's system.
4. The following training shall be provided, as a minimum:
 - a. 1. Training in standard hardware maintenance.
 - b. 2. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged connected and set up for this Contract.
 - c. 3. Test, adjustment and calibration procedures
 - d. 4. Troubleshooting and diagnostics
 - e. 5. Periodic maintenance
 - f. 6. A walk-through of the installed system explaining each major component of the system.

3.05 CONTROL SYSTEM DIAGRAMS AND DETAILS

- A. To assist the PICS in determining the scope of work, a series of schematic diagram drawings and details are provided. Unless specifically stated otherwise, the PICS shall be responsible for providing all instrumentation, control equipment and auxiliary devices necessary to perform the functions specified herein and as shown and described on the Drawings. Any auxiliary devices such as lightning/surge protectors, relays, timers, signal isolators, signal boosters, etc., which are necessary for complete operation of the system, or to perform the functions specified, shall be included whether or not they are specifically shown or tabulated on the loop drawings.
- B. The intent of the loop drawings (as shown in the Drawings) are to describe in as much detail as possible, the hardware, software and functional requirements of a process measurement and control system. They are not intended to convey requirements for conduit and wiring between panels or system components. This information is included in appropriate electrical Specifications and Drawings. Any additional wiring or raceway required for a fully operational system shall be provided at no additional cost to the Owner.

END OF SECTION

SECTION 25 00 10

APPLICATION ENGINEERING SERVICES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The General Provisions of Section 25 00 00 shall apply to this section.
- B. All work in this Section shall be the product of the Process Instrumentation and Control Supplier (PICS). Sub-suppliers and/or manufacturers may provide components, and/or services to the PICS, but the final product shall conform to this specification and shall be the sole responsibility of the PICS.
- C. The PICS shall provide all applications programming and services required to achieve a fully integrated and operational system. The PICS shall coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other sections of these Specifications and with related existing equipment.
- D. Auxiliary and accessory programming structures necessary for system operation or performance shall be included whether or not they are specified or shown on the Contract Drawings.
- E. All equipment shall be controlled in full conformity with the Specifications, Drawings, engineering data, instructions and recommendations of the equipment manufacturer.
- F. To facilitate the Owner's future operation and maintenance requirements, all programming and operator interface development shall utilize standards as agreed upon by the Owner and Engineer.
 - 1. The PICS shall coordinate and schedule all testing procedures with the General Contractor.
 - 2. Refer to electrical and instrumentation drawings for I/O requirements.

1.02 RELATED WORK

- A. Refer to Section 25 00 00.
- B. Refer to Section 25 00 20

1.03 SUBMITTALS

- A. Refer to Section 25 00 00.
- B. Submittals listed below shall be provided, as a minimum. Each submittal must be complete in order to be reviewed by the Engineer.
 - 1. Project Plan Submittal
 - 2. Field Instruments Submittal

3. Control Panel Drawings Submittal
4. Control Narrative Submittal
5. Programming Standards Submittal
6. Preliminary Graphics Submittal
7. 70% Graphics Submittal
8. Final Graphics Submittal
9. PLC Programming Submittal
10. Factory Test Plan (FAT) Submittal
11. Cutover Plan Submittal
12. Site Acceptance Test Plan (SAT) Submittal
 - a. Preliminary Graphics Submittal
 - b. Testing - Refer to Section 25 00 00.
 - c. Training - Refer to Section 25 00 00
 - d. O&M Manuals - Refer to Section 25 00 00.

1.04 SYSTEM DESCRIPTION

- A. The PICS is responsible for providing all applications programming and configuration services to accomplish the control and monitoring functions described in the Specifications and Contract Drawings. The PICS shall provide all programming functions. The PICS shall also provide all application programming and configuration services necessary to produce the HMI graphic displays, reports, trends, historical archive, etc. as described in the Specifications and Contract Drawings.
- B. Prior to developing HMI screens, the PICS shall meet with the City and Engineer and show them sample HMI screens to use as a basis for development. Provide for a minimum of the following control system design meetings:
 1. Pre-Design & Programming Standards Review Meeting (1 day - Onsite)
 2. Control Narrative Review Meeting (1 day – MS Teams)
 3. Preliminary Graphics Submittal Review Meeting (1 day – MS Teams)
 4. 70% Graphics Submittal Review Meeting (1 day – MS Teams)
 5. Final Graphics Review Meeting (1 day MS Teams)
 6. Factory Testing (2 days hybrid onsite and PICS facilities)
 7. Cutover Plan Review Meeting

- C. PICS shall develop and provide customized graphics to replace, modify or create screens within the existing VTSCADA application. Customized graphic displays (not including standard trends, pop-up windows, HMI supplied displays, etc.) to illustrate the modified plant process control systems. All graphic displays shall be designed by the PICS utilizing the HMI software and shall be approved by the Engineer/Owner. These displays shall be prepared and submitted for review at the second coordination meeting. The displays shall represent all process control systems and all associated equipment, pumps, valves, gates, feed systems, filters and auxiliary systems. The PICS shall establish a consistent process control philosophy, standard graphical layout and standard graphical symbolic representation for all displays. Existing screens for instruments and controls that are not modified shall be preserved (i.e. chlorine residual monitoring, turbidity monitoring, etc.). The PICS shall provide the following list of displays as a minimum:

1. Modified Plant Overview Menu (Plan View)
2. System/Communications (SCADA Block Diagram)
3. Flow Summary
4. Raw Water Flow Measurement and Control
5. Re-Mineralization System
6. Chemical Feed Systems
7. Rapid Mix Systems
8. Post Chemical Mix Systems
9. Sample Pump Monitoring
10. Modified Clearwell Levels
11. High Service Pump Station
 - a. Backwash Pumps and Flow Control
 - b. Trends, Alarms, Historical Data

1.05 PROGRAMMING AND CONFIGURATION GUIDELINES AND DELIVERABLES

A. Real Variables Processing

1. Real variables shall represent process data for which there are analog signal inputs to the system. The system shall sample each of these input signals at the selected scan frequency and perform the proper conversions and scaling to obtain the instantaneous engineering values. These values shall be used to update real-time data on HMI displays, check for alarm conditions and store for use in historical files.
2. The instantaneous values of all variable data shall be displayed on the appropriate HMI display and shall be added to the historical database whenever the present value exceeds a preprogrammed compression dead band. The compression dead band will be field adjusted by the PICS to provide for maximum storage utilization.

3. Variables such as rate of flow, weight and kilowatt usage shall have their instantaneous values integrated with respect to time and their quantities totaled before archiving.
4. Alarm conditions shall be stored in a separate historical file. In addition, the last 500 alarms shall be displayed on the alarm graphic display. The alarm storage format shall be an alarm description, true time of occurrence, and tag number.

B. Manual Input Data Handling

1. The application software shall provide the capability to manually enter data from any operator's computer keyboard. This data shall consist of additional values for the current data file (e.g., laboratory analyses), inserting alarm limits, set point changes, adjustment to process constants, control system set point changes and system tuning parameter adjustments.
2. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the data entry device prior to incorporation to the database.

C. HMI Graphic Displays

1. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers.
2. The HMI displays shall make maximum use of the colors available. Color for status such as open/close, start/stop shall be the same as the indicators used on the existing process control system. PICS shall have designated colors for Raw Water, Process Water, Waste, Backwash, etc. All colors shall be approved by the Owner.
3. The HMI displays shall be interlinked for easy and direct operator call up. They shall be available for viewing be either entering the display name (via keyboard) or via a "hot spot" on the current display screen (mouse driven cursor movement and pick button). All displays shall have "hot spots" for, at a minimum, the Alarm Summary display, Plant Overview Menu display and the Summary Menu display.
4. The system shall allow the operator to manually control the status of pumps, valves, etc. via either keyboard entry or the currently displayed graphic display. The status change shall require a secondary acknowledgement (action confirmation) by the operator before the command is processed.
5. Unless specifically noted, all timers, set points, alarm actuation levels, etc. shall be operator adjustable from the HMI, subject to Owner-defined user access and privileges.
6. Menu displays shall be provided as a guide to the available display options. The menu displays shall be a complete and logical listing of the names and number of all displays.
7. Graphic displays shall depict basic process schematic diagrams with representative symbols for pumps, tanks, etc. combined with real time process variables or conditions. The equipment represented on the display shall be suitably titled for identity. The displays shall be dynamic (i.e., symbols for a pump shall change color indicating run or stop or alarm, the volume of tanks shall be indicated by varying the height of the interior color of the tank symbol, etc.). Its name and tag number shall identify the data on the display. All of the current data in the database shall be available for graphic displays. It shall be possible to easily modify an existing display or generate a new display. The graphic

displays shall consist of a single master plant flow schematic and multiple sub-displays detailing specific plant systems or elements. The process graphic displays shall consist of Master, Area and System displays. The Master and Area displays shall show general graphic representations of the facility covered with general equipment, alarm, analytical summaries and control capabilities. The System display shall detail all relevant aspects of the individual equipment or system (i.e., an individual pump). The intent is to provide the operator with an overview (Master) with the capability of “zooming in” on a process (Area) or a piece of equipment (System) as necessary. The PICS shall use the Instrumentation and Piping Diagrams as part of this Contract to generate the graphic displays. All process variables shall be displayed on their associated display (s) in engineering units. The Engineer/Owner shall approve color standards for the equipment symbols, process piping, etc.

8. Analog trend displays shall display the value of a minimum of eight (8) assigned points versus time. The intent is to depict the type of plot produced on an analog recorder on the HMI display. Each point shall be trended in a different color. Each of the assigned points shall have a point identification number, point name, point description, current value and instrument range display in the color used for its trend. The time period shall be selected and be either current or historical. The time period selected and time and date of start shall be displayed. The values displayed on a historical trend shall consist of the stored values for each variable trended. Current trends shall be updated at the scan frequency of the variable. A trend display shall not be considered a graphic display.
9. Manual laboratory data summary displays shall consist of all laboratory inputs, displaying the tag numbers, tag name, the current value and the date and time that the value was entered.
10. Alarm summary displays shall consist of all points currently in alarm and shall include the tag number, description, true time of occurrence and present status, (high, low, normal, etc.). The alarm summary shall identify alarm points by severity (event, attention, caution and urgent) by utilizing distinct colors for each severity category. The severity classification shall be easily changeable by the Owner.
11. System status displays shall summarize the error status of all system devices capable of reporting errors to the CPU (i.e., printers, communication devices, etc.). The display shall indicate if an error is detected or a failure occurs. It shall also allow assignment of those items capable of acting as back up to other devices. These displays shall be used primarily for maintenance purposes.
12. Single point configuration / status displays shall be of the HMI software manufacturer's standard format.
 - a. Where data is pulled from vendor furnished control panels (Remineralization System, Chemical Metering Pumps, Flow Controllers, etc.) via Modbus TCP/IP. In general, the PICS shall display all available data from the vendors processor on the Owner's HMI screen regardless of what is shown on the P&ID drawings. PICS shall coordinate map address points with vendors.
13. Alarm / Equipment Status Reporting

- a. The alarm log shall display all alarms as they occur. The alarm message shall include the time occurrence, tag name, tag number and whether it is a low, high or failure alarm. When the point in alarm returns to normal, the time, point identification number and “return to normal” shall be displayed. All reports shall include the plant equipment number of the associated device.
- b. Equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The status monitoring shall be capable of being disabled and/or suppressed from the operator workstation. The equipment status log shall include the time, equipment name, tag number and the particular change in status.
- c. All alarms and events shall be displayed on the display and archived. No alarm or event shall be printed automatically; however, alarms and events shall be available for printing on demand for operator-specified time periods. Alarm information shall consist of point identification number, point name, time of occurrence and type and priority of alarm.
 - 1) All alarms shall be placed in a separate historical file and be easily accessible for use as needed. The PICS shall maintain ninety (90) days of “as logged” raw data and twelve (12) months of partially compressed raw data on the server. The PICS shall recommend the number of additional days or month’s data may be retained based on the capacity of the new system.
 - 2) The equipment and point status summary report shall log the status of all points in the system, including contact inputs, real variables with analog inputs and calculated variables. When required this printout will be initiated manually and shall consist of the tag number, tag name and its current status (i.e., Running, Off, High, Low, Active, Disabled, On-scan, Off-scan, etc.).
 - 3) The summary printout shall summarize all alarms for the previous 24-hour period. Normally, this printout shall be initiated manually but provision shall be made so that it may be initiated automatically every day, if desired. The printout shall be generated on-line from stored data. This printout shall consist of all data in the initial alarm occurrence and return to normal, as specified.
 - 4) The current alarm summary printout shall print all points currently in alarm. This printout shall be initiated manually, as required. The printout shall be generated on-line from stored data. This printout shall consist of all points currently in alarm.
 - 5) The capability shall be provided to sort both daily and current alarm summary reports by operator defined groups. (i.e., print all power failure alarms, etc.).
 - 6) The alarm summary printout shall be initiated manually, as required, be generated from stored data on the server and shall consist of the point identification number and the point name.
- d. Historical Data Management.
 - 1) The following features shall be provided for processing and storage of system historical data:
 - a. Data Processing and Storage. The real time instantaneous values shall be stored in a historical log file on the server. The PICS shall maintain ninety (90) days of “as logged” raw data and twelve (12) months of partially compressed raw data on the server. The PICS shall recommend the number of additional days or month’s data may be retained based on the capacity of the new system.

- 2) Data Archiving. Historical data shall be automatically alarmed and stored on the harddrive. The intent is to ensure that a long-term record of historical information is available to support future studies, etc.
- 3) Each system point (analog or digital, real or pseudo) shall have the capability of being historically logged. A point shall have the capability of being deleted from the historical log at any time. It shall be easy to add or delete system points using minimal keystrokes.
- 4) Displays used for historical analysis (such as historical trends, alarms/events summary, etc.) shall have similar capabilities to those used for real time data review. The source of data shall be the HMI's database.
- 5) The ability to produce ASCII and CSV files which can be used in most of the commercial spreadsheet programs (e.g., Lotus and Excel) and database programs (e.g., Paradox, Oracle, Access) shall be provided.
 - a) Report Definition.
 - 6) Exact report formats and data to be reported shall be determined by the Owner and be developed by the PICS.
 - 7) Provide for development of (5) custom reports and a minimum of 2 days development time for each.
 - a) Alarm Notification
 - 8) The existing HMI software is linked to alarm notifications. During start-up, PICS shall coordinate with Owner all new alarms to be monitored and transmitted, and existing alarms transmitted as before the work began.

PART 2 - PRODUCTS

- A. The Human Machine Interface shall be the latest version of VTSCADA, or engineer approved.
- B. The existing VTSCADA Dual Server Premium software is licensed for 1k Tags. This license shall be upgraded to 5k Tags.
- C. The reporting software shall be XL Reporter by SmartSights (latest version) for VTSCADA. Provide (1) license for each server. Provide for a minimum of (3) simultaneous XL Reporter users as applicable. The XL Reporter software shall be capable of data connection to VTSCADA realtime, hortalical, and alarm data.

PART 3 - EXECUTION

3.01 TESTING

- A. Refer to Section 25000.

- B. In addition to the tests specified in Section 25000, as part of the Site Acceptance Testing (SAT), perform the following:
 - 1. Building and loading the database
 - 2. Conduct online modifications to the database
 - 3. Demonstrate operability of the interfaces (hardware and software)
 - 4. Demonstrate all system software functions specified
- C. Demonstrate operability of all process control strategies, graphic screens and reports
- D. Verify the displays and all interactive capabilities of the operators workstations
- E. Simulate selected operating conditions to verify the performance of the monitoring and control functions
- F. Demonstrate the performance of the historical database
- G. Demonstrate the performance of the alarm and event logging system
- H. Demonstrate the ability to share data between operator workstations
- I. Demonstrate the ability of each workstation to print reports and graphic displays
- J. Demonstrate the ability for each workstation to read and write to and from designated files from other workstations over the LAN

END OF SECTION

SECTION 25 00 20

PANELS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The General Provisions of Section 25 00 00 shall apply to this section.
- B. Furnish all labor, materials, equipment and incidentals required to fabricate, complete and ready for operation, the panels depicted on the Drawings and in the Panel List below.
- C. All work in this Section shall be the product of the Process Instrumentation and Control Supplier (PICS). Sub-suppliers and/or manufacturers may provide components, enclosures and/or fabrication services to the PICS, but the final product shall conform to this specification and shall be the sole responsibility of the PICS.

1.02 RELATED WORK

- A. Refer to Section 25 00 00.

1.03 SUBMITTALS

- A. Panel submittals shall be prepared and transmitted to the Engineer for approval in compliance with Section 250000 of these specifications. In addition, shop drawings shall include the following information:
 - 1. Materials for all panels and enclosures.
 - 2. Drawings shall be prepared on 11" by 17" paper, shall be to scale and shall show the location of panel mounted devices as well as doors, louvers and sub-panels.
 - 3. Drawings shall include a panel legend and a bill of materials.
 - 4. The panel legend shall list and identify front of panel devices by their assigned tag numbers, nameplate inscriptions, service legends and annunciator inscriptions.
 - 5. The bill of materials shall list devices mounted within the panel that are not listed in the panel legend and shall include the tag number, description, manufacturer and model number for each item.
- B. Interconnecting Wiring Diagrams
 - 1. Provide interconnecting wiring diagrams showing electrical connections between panels, consoles, terminal junction boxes and field mounted components.
 - 2. Diagrams shall show component and panel terminal identification numbers and external wire and cable numbers.
 - 3. Circuit names corresponding to the Conduit Schedule shall be shown.

4. These diagrams shall be coordinated with the Electrical Subcontractor and shall bear his mark showing that this has been done.

1.04 SYSTEM DESCRIPTION

- A. Refer to Section 25 00 00.
- B. The following PLC based panels shall be furnished by the PICS as specified under this Section. Refer to the Drawings for size, location and contents of each panel.

LCP No.	Location	Notes
SCADA LCP-1	Control Building	Nema 12 (Interior)
SCADA LCP-2	High Service Pump Station	Nema 4X Stainless Steel (Interior, exposed to splashing)
SCADA LCP-3	Lime/CO2 Rapid Mix Area	Nema 4X Stainless Steel (Exterior)
SCADA LCP-4	Chemical Building	Nema 12 (Interior)

1.05 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 25 00 00.
- B. The panels and consoles shall be mounted on wood skids four inches high. Adequate crating shall be provided to protect the panels or consoles from damage during shipping.
- C. Instruments and components shall be blocked and tied down to prevent damage during shipping. Front-panel mounted instruments or components shall be removed or securely protected from damage during shipment. Items removed from the panels shall be repacked in their original containers and shipped with the panel.
- D. Accessories, drawings, instruction bulletins, etc. shall be packed and shipped with the associated panel.

1.06 SPARE PARTS AND TEST EQUIPMENT

- A. Provide spare parts and test equipment as specified in Section 250000 and as indicated below.
 1. Fuses: 20 percent of each size and type used, but no less than ten of each size and type.
 2. Relays: 10 percent of each type used, but no less than five of each type.
 3. Indicating Light Bulbs: 25 of each size and type used.
 4. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.
 5. Five spare pilot indicating lights, rotary hand switches, pushbuttons of each type used.

6. One spare analog indicator of each type used.
 7. Corrosion Inhibiting Vapor Capsules: Provide 20 of each type and size used.
 8. PLC Hardware: Provide 1 spare of each type of PLC card used.
- B. All spare parts shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

PART 2 - PRODUCTS

2.01 CONTROL PANEL GENERAL REQUIREMENTS

- A. Furnish and install the panels per the Specifications and Drawings.
- B. The construction and wiring for the panels shall be in accordance with this Specification and applicable panel drawings. The panel drawings will specify the arrangement of instruments to be mounted on the front, rear and sides of the panels.
- C. All panels shall be fully enclosed for use with high-density instrumentation mounting.
- D. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.
- E. The instruments and equipment designated for rear-of-panel mounting shall be arranged within the panel according to associated panel drawings in a manner to allow for functionality, ease of maintenance and adjustment.
- F. Conductors running from the field to the panels shall be continuous without splices, except at approved junction boxes. All junction boxes and panels shall have 20 percent spare terminals.
- G. Conduits and cables entering panels shall be sealed to prevent the intrusion of gas and moisture.
- H. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates, in such a manner that the component may be removed without removing the plate and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required by the manufacturer to protect equipment from vibration. Mounting orientation shall be in accordance with the requirements of each component.
- I. Components shall be identified with suitable plastic or metal engraved tags attached adjacent to (not on) each component identifying the component in accordance with the Drawings, Specification and PICS data.
- J. The internal framework of each panel shall permit panel lifting without distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the panel during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete.

- K. All panels, consoles and exterior mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- L. All panels shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Nameplates shall be provided for all flush mounted equipment in the interior and exterior of each panel. Nameplates shall be constructed of white and black laminated phenolic material having engraved letters extending through the white face into the black layer. Nameplate shall be beveled and attached to panels by adhesive or glue.
- M. Provide a sun / rain shield over enclosure for all outdoor panels.

2.02 PANEL MATERIALS AND CONSTRUCTION

A. General

1. All panels located in indoor areas, unless otherwise specified, shall be NEMA 12 construction.
 - a. Freestanding panels shall be constructed of 12 gauge or thicker steel, suitably braced internally for structural rigidity and strength. All exposed welds, seams or edges shall be ground smooth.
 - b. Wall or Unistrut mounted panels shall be constructed of 14 gauge or thicker steel. All exposed welds, seams or edges shall be ground smooth.
 - c. Front panels or panels containing instruments or components shall be 10 gauge or thicker sheet steel reinforced to prevent warping or distortion.
 - d. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument or component mounting.
 - e. All doors shall be lockable, mounted with strong, continuous, piano type hinges and shall be provided with door handles and three point latches or screw clamps.
2. All panels located in outdoor areas, or in indoor areas where otherwise specified, shall be NEMA 4X Type 316 stainless steel construction.
 - a. Freestanding panels shall be constructed of 12 gauge or thicker Type 316 stainless steel, suitably braced internally for structural rigidity and strength. All exposed welds, seams or edges shall be ground smooth.
 - b. Wall or Unistrut mounted panels shall be constructed of 14 gauge or thicker Type 316 stainless steel. All exposed welds, seams or edges shall be ground smooth.
 - c. Front panels or panels containing instruments or components shall be 10 gauge or thicker Type 316 stainless steel reinforced to prevent warping or distortion.
 - d. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument or component mounting.
 - e. All doors shall be lockable, mounted with strong, continuous, piano type hinges and shall be provided with door handles and three point latches or screw clamps.

3. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel drawings. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments or control devices.
4. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings.
5. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts or other accessories as required to maintain the NEMA rating of the panel and the electrical rating of the conduit system.

B. Finish Requirements

1. All panel sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be furnished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane or lacquer finish, which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel and fiberglass-reinforced polyester panels will not require a paint finish.
2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with solvent. Surface voids shall be filled and ground smooth.
3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before the final top coat is applied.
4. The panel interior shall have a minimum of two coats of flat white lacquer after priming.
5. Unless otherwise noted, the finish exterior colors shall be selected by the Owner from color chips supplied by the PICS.

C. Manufacturers

1. The panels shall be manufactured by Hoffman or Engineer approved equal.

2.03 CONSOLE MATERIALS AND CONSTRUCTION

A. General

1. All consoles located in outdoor areas, unless otherwise specified, shall be NEMA 4X construction.
 - a. Freestanding consoles shall be constructed of a one-piece molded fiberglass-reinforced polyester material, suitably braced internally for structural rigidity and strength with a minimum wall thickness of 0.125 inch thick.
 - b. Surfaces containing instruments or components shall be a minimum of 0.25 inch thick and reinforced to prevent warping or distortion.

- c. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument or component mounting.
 - 2. Consoles shall be provided with front and rear access lift off doors with Southco Type 44 latches as shown on the panel drawings.
 - a. The console shall be suitable for bottom conduit entry as required by the Electrical Drawings.
 - b. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts or other accessories as required to maintain the NEMA rating of the panel and the electrical rating of the conduit system.
 - 3. Finish Requirements
 - a. Consoles shall be maintenance free using molded-in colors that never require painting, fade or wear off. The finish shall be satin gloss and gel-coated.
 - b. The consoles shall have all edges rounded and ground smooth for safety and appearance.
 - c. Unless otherwise noted, the finish exterior colors shall be selected by the Owner from color chips supplied by the PICS.
 - 4. Manufacturers
 - a. The consoles shall be manufactured by Warminster Fiberglass or Engineer approved equal.
- 2.04 TEMPERATURE CONTROL
 - A. Freestanding panels shall be provided with louvers, forced air ventilation or air conditioning as required to prevent temperature buildup due to ambient temperature conditions and/or electrical devices mounted in or on the panel.
 - B. Panels that require louvers shall have them mounted on the rear at the top and bottom of the panel unless the panel is located against a wall, then they shall be mounted on the sides.
 - C. Panels that require forced air ventilation fans shall provide a positive internal pressure within the panel and shall be provided with washable or replaceable filters. Fan motors shall operate on 115 VAC, 60 Hz power.
 - D. Panels that require air conditioning shall use side-mount air conditioners manufactured by Hoffman Proair or Engineer approved equal. Air conditioners shall operate on 115 VAC, 60 Hz power.
 - E. The internal temperature of all panels shall be regulated so as not to exceed 100⁰ F.
 - F. The panel cooling equipment shall not compromise the NEMA rating of the panel.
- 2.05 CORROSION CONTROL
 - A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Hoffman or Engineer approved equal.

2.06 INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. Panel equipment and components shall be mounted and wired on or within the panel or console. Wiring shall comply with the National Electric Code. Wiring within the panel shall be grouped together with wire ducts and secured to the structure. Wiring shall be numbered in compliance with the numbering system used on the wiring / connection diagrams. Wiring and connection diagrams shall comply with ISA S5.4 Instrument Loop Diagrams and shall be as part of the Shop Drawings for review by the Engineer.
2. Power wires shall be 14 AWG Type THWN stranded and shall be insulated for not less than 600 volts. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90° C.
3. Control wires shall be 16 AWG Type THWN stranded and shall be insulated for not less than 600 volts. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90° C.
4. Analog signal cables shall be single pair 16 AWG shielded cable with a ground wire. Conductors shall be of tinned copper construction.
5. All wiring leaving or entering the panel shall be terminated on terminal blocks that are rigid, numbered and located for ease of access and troubleshooting.
6. Terminal strips shall be separated into groups for power, control and analog signals.
7. Terminal strips and/or block systems shall be manufactured by Phoenix, Allen Bradley or Weidmuller and shall be rated for a minimum of 600 volts.
8. Wire ducts for supporting internal wiring shall be a plastic type with snap on covers.
9. Each wire shall be provided with a numbered and typed heat shrink tubing identification marker at both ends. Handwritten markers or paper markers will not be permitted. Each individual wire shall be assigned a number that corresponds to the number shown on the Drawings.
10. Each freestanding panel shall have a switched single-tube 20 Watt fluorescent light fixture mounted internally in the ceiling of the panel manufactured by Hoffman.
11. Each panel shall have a duplex convenience receptacle mounted internally within the panel in an appropriate steel box and cover.
12. A single lamp test button shall be provided on a panel, where appropriate, to test all of the indicator lamps in the panel at the same time.
13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Grounding shall be in accordance with the instrumentation manufacturer's recommendations.

14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the National Electric Code.
15. Each panel shall be provided with analog signal isolation (I/I) when analog signals are sent from one panel or console to another.
16. Each panel shall be provided with surge suppression protection (electrical transients) for connections between AC power systems and electrical or electronic equipment. Surge suppressor grounding shall be in accordance with the manufacturer's recommendations.
17. Each panel shall be provided with a circuit breaker power disconnect switch.
18. Each digital output shall be wired to an interposing relay and one normally open contact from each relay shall be wired to the terminal strip. The contact shall be rated for 115 VAC, 10 Amp or 24 VDC, 10 Amp.

B. Print Storage Pockets

1. Print storage pockets shall be provided on the inside of each panel or console. Its size shall be sufficient to hold all of the prints and documentation necessary to service the equipment attached to it or within it.

C. Equipment Shelves

1. Equipment shelves shall be provided as necessary to support miscellaneous equipment that is normally not mounted or fastened directly to a panel.
 - a. SCADA System Data Highway Fiber-Optic Ethernet Switches
2. Shelves shall be fabricated out of aluminum sheet metal and shall be fastened securely to the equipment panel within the enclosure.

2.07 MISCELLANEOUS PANEL COMPONENTS

A. Panel Meter - Digital Readout

1. Type
 - a. Numerical digital process meter.
2. Functional Performance
 - a. The meter shall be a 3-½ digit minimum resolution LED indicator and shall display the value of the analog input signal in engineering units with a scaled range, as noted. The decimal point shall be field selectable and the meter shall provide an over range indication.
 - b. Accuracy shall be 99.9 percent.
 - c. Power requirements shall be 120 VAC or 24 VDC, as required.
 - d. The operating temperature limits shall be 0 to 60° C.
3. Physical

- a. The meter shall be housed in a NEMA 4X high impact plastic enclosure with a splash proof lens.
 - b. The meter shall provide a permanent service legend to display the engineering units of the process variable.
 - c. The meter dimensions shall not exceed 4" wide x 2" high x 5" deep.
 - 4. Manufacturers
 - a. The digital readout panel meter shall be Model PD690 as manufactured by Precision Digital or Engineer approved equal.
- B. Pilot Indicating Lights
- 1. Type
 - a. Heavy-duty oil tight type utilizing low voltage lamps with integral lamp test.
 - 2. Functional Performance
 - a. Units shall be provided with low voltage lamps suitable for 24 VDC power.
 - b. Units shall provide for a remote lamp test function.
 - c. Lamps shall be replaceable from the front of the unit.
 - 3. Physical
 - a. Lens colors shall be as indicated on the Drawings and shall be approximately 1 ¼ inch in diameter.
 - b. Provide legend nameplates engraved to indicate the required function of each device.
 - c. Units shall be rated NEMA 4X for outdoor weatherproof conditions.
 - d. Manufacturers
 - 4. The pilot indicating lights shall be Model 800T as manufactured by Allen Bradley or Engineer approved equal.
- C. Rotary Hand Switches and Pushbuttons
- 1. Type
 - a. Control devices shall be heavy-duty oil tight type with stackable contact blocks.
 - 2. Functional Performance
 - a. Provide control devices, switch configurations as required for the control system specified and as shown on the Drawings.

3. Physical

- a. For 115 VAC service, provide contacts rated 10 Amps at 115 VAC, for 24 VDC service provide contacts rated 5 Amps at 125 VDC, for electronic (millivolt / milliamp) switching provide gold plated contacts rated at 28 VDC.
- b. Pushbuttons shall have flush type operators and selector switches shall have knob or wing lever operators.
- c. Provide legend nameplates engraved to indicate the required function of each device.
- d. Units shall be rated NEMA 4X for outdoor weatherproof conditions.

4. Options / Accessories Required

- a. Provide lockout pushbuttons, key-operators, etc. as indicated on the Drawings.
- b. Provide make-before-break bridging contacts as required for the control system specified.

5. Manufacturers

- a. The rotary hand switches and pushbuttons shall be Model 800T as manufactured by Allen Bradley or Engineer approved equal.

D. General Purpose Relays and Time Delay Relays

1. Type

- a. Units shall be general-purpose plug-in type.

2. Functional Performance

- a. Provide general-purpose control relay and time delay relay configurations as required for the control system specified and as shown on the Drawings.
- b. Mechanical life expectancy shall be in excess of 10 million operations and the duty cycle shall be rated for continuous operation.
- c. Relays shall be provided with an integral indicating light to display when a relay is energized.
- d. Solid-state time delay relay periods shall be 0.1 second to 4.5 hours and shall be adjustable, provided with polarity protection and transient protection.

3. Physical

- a. For 115 VAC service, provide contacts rated 10 Amps at 115 VAC, for 24 VDC service provide contacts rated 5 Amps at 125 VDC, for electronic (millivolt / milliamp) switching provide gold plated contacts rated at 28 VDC.
- b. Relays shall be provided with dust and moisture resistant covers.

4. Options / Accessories Required

- a. Provide all mounting rails, mounting sockets, etc. that are required.
- 5. Manufacturers
 - a. The general-purpose relays and time delay relays shall be Model 700HF as manufactured by Allen Bradley or Engineer approved equal.
- E. Signal Isolators / Boosters / Converters
 - 1. Type
 - a. Solid-state electronic type.
 - 2. Functional Performance
 - a. Provide signal isolators, boosters or converters as required for the control system specified and as shown on the Drawings.
 - b. Accuracy shall be 0.15 percent or better.
 - c. Inputs shall be current, voltage, frequency, temperature or resistance as required.
 - d. Outputs shall be current or voltage as required.
 - e. Isolation shall be complete between input circuitry, output circuitry and the power supply.
 - f. Zero and span adjustments shall be provided.
 - g. RFI protection shall be provided.
 - 3. Physical
 - a. Units shall be suitable for mounting in a rack or an enclosure.
 - b. Units shall be provided with dust and moisture resistant covers.
 - 4. Options / Accessories Required
 - a. Provide all mounting rails, racks, etc. that are required.
 - 5. Manufacturers
 - a. The signal isolators / boosters / converters shall be Series 4000 as manufactured by AGM or Engineer approved equal.
- F. F. Surge Protection
 - See Section 13660

2.08 UNINTERRUPTIBLE POWER SUPPLY

- A. An Uninterruptible Power Supply (UPS) shall be provided for each new panel or console. The UPS shall protect all PLC equipment, including remote I/O, instrumentation, power supplies, etc.
- B. The UPS shall be based on ferroresonant technology, preventing spikes, sags, surges, noise and harmonics from adversely affecting equipment. Input power shall be 120/208/ 240 VAC as indicated on the drawings, 60 Hz. Output power shall be 120 VAC, 60 Hz.
- C. The UPS shall contain hot-swappable internal backup batteries sufficient to allow all connected equipment to run continuously after a normal power failure for one or four hours as stated below in the UPS Schedule. PICS shall submit power calculations for each UPS system to be reviewed by the Engineer.
- D. The UPS shall automatically switch to battery power upon loss of normal power and back to normal power upon return to normal conditions, using a continuous no-break connection to ensure that there are no momentary power interruptions.
- E. The UPS shall be housed in a NEMA 1 enclosure and shall be securely mounted within a NEMA 12 panel, console or battery cabinet as shown on the Drawings.
- F. Additional batteries, where required to meet the specified runtime, shall be housed in a NEMA 12 enclosure located adjacent to the PLC panel as shown on the Drawings.
- G. The UPS shall include auto-diagnostics and communications capabilities, accessible through a RS-232 port.
- H. The UPS shall be Best Power, Ferrups Model FE or Engineer approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Refer to Section 250000.
- B. The panels and consoles shall be factory tested and approved by the Engineer prior to shipment.
- C. The panels and consoles shall be installed at locations as shown on the Drawings.

3.02 FACTORY ACCEPTANCE TEST (FAT)

- A. Refer to Section 250000.
- B. All panels and consoles shall be tested for proper operation and approved by the Engineer at the PICS factory, or other selected site, prior to shipment to the Jobsite.
- C. Tests shall demonstrate all specified control functions by simulating inputs and outputs to the panels, communication to and from the SCADA and HMI systems, etc.
- D. Acceptance of factory tests by Owner or Engineer shall not constitute a waiver of requirements to meet field tests under specified operating conditions, nor does inspection relieve the PICS of his responsibility in any way.

END OF SECTION

SECTION 26 00 00

GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install all materials, equipment, labor, supervision and services necessary to complete all electrical work specified herein, and shown on the Drawings.
- B. Principal Features
 - 1. Install Owner provided equipment (Switchboard & Service Entrance Automatic Transfer Switch)
 - 2. Power and Controls for new high service pumps
 - 3. Electrical System Analysis
 - 4. Complete system of conduits, cables and conductors to supply electrical energy throughout the facility.
 - 5. Lighting fixtures, ballasts, and lamps.
 - 6. Electrical demolition of existing HSPS
 - 7. Installation of Control Panels instruments
 - 8. All field terminations, including instruments, and installation of Owner provided SCADA panels.

1.02 APPLICABLE STANDARDS AND CODES

- A. Local, State, and National Electrical Codes.
- B. National Electrical Code, 2023.
- C. Rules of the Electrical Utility and the National Electrical Safety Code.
- D. Life Safety Code 101.
- E. NECA Standard of Installation.
- F. NFPA (National Fire Protection Association).

1.03 FEES AND TESTS

- A. Contractor shall be responsible for all fees for permits, inspections, and tests necessary to complete this work. Contractor shall demonstrate to the Owner and the Engineer that all items of equipment installed are completely operational and free of defects in all modes.
- 1.04 COORDINATION WITH OTHER TRADES
- A. Furnish and locate all anchor bolts, inserts and supports for installation by the other trades as required. Coordinate the location of all fixtures, outlets, equipment, and devices with other trades to avoid conflicts.
- 1.05 LIST OF PROPOSED MANUFACTURERS
- A. List of Proposed Materials: The Contractor shall submit a complete list of the proposed manufacturers for each proposed items as required to complete the work. Additional submittal data, sufficient to determine equality, shall be required if the Contractor proposes to substitute another manufacturer's equipment.
- 1. Intent of Drawings
 - a. Electrical plan drawings show only general locations of equipment, devices and raceways, unless specifically dimensioned. The Contractor shall be responsible for the proper routing of raceway, subject to the review of the Engineer.
 - 2. Departures from Contract Documents
 - a. Submit to the Engineer in writing details of any necessary, proposed departures from these Contract Documents, and the reasons therefore. Submit such requests as soon as practicable and within 30 days after award of the Contract. Make no such departures without written approval of the Engineer.

PART 2 - PRODUCTS

2.01 REFERENCE TO DRAWINGS

- A. Reference shall be made to Drawing Schedules, Details, Notes, and Specifications for: Manufacturer, model, catalog number, size, capacity, performance, ratings and installation of equipment and material.

2.02 CHOICE OF MATERIALS AND EQUIPMENT

- A. In submitting substitutions, bidders should note the following minimum considerations: (1) capacities shown are absolute minimal and must be equaled, (2) physical size limitations for space allotted, (3) structural properties, (4) noise level, (5) interchangeability, (6) compatibility with other materials and assemblies, (7) similar items shall be same manufacture and style wherever possible.
- B. All material and equipment, for which a UL, ANSI, or a NEMA Standard is established, shall be so approved and labeled or stamped.
- C. Adhesives are not acceptable as a mounting, supporting, or assembling technique, unless noted otherwise.

2.03 ELECTRICAL EQUIPMENT

- A. NEMA Standards shall be taken as minimum requirements for electrical equipment.
- B. Equipment shall operate properly under a plus or minus 10 percent of the system voltage.

2.04 SUBMITTALS DURING CONSTRUCTION

- A. Provide complete manufacturers' descriptive information and shop drawings for all permanently installed equipment, material and devices furnished under Division 26, Electrical, including certified outline drawings, arrangement drawings, elementary (schematic) diagrams, interconnection and connection diagrams, in accordance with provisions elsewhere in these Contract Documents. Provide the number of copies specified in Section 01 33 00. Operation and Maintenance Manuals shall be submitted in accordance with Section 01 70 00.
- B. Provide certified shop drawings, literature and requested samples showing items proposed for use, size, dimensions, capacity, special features required, schematic (elementary) control diagrams, equipment schedules, rough-in, etc., as required by the Engineer for complete review and for use during installation. Use NEMA device designations and symbols for all electric circuit diagrams submitted. Make content of the schematic (elementary) connection or interconnection diagrams in accordance with the latest edition of NEMA ICS 1.
- C. Manufacturer's standardized elementary diagrams will not be acceptable unless applicable portions of the diagram have been clearly identified and non-applicable portions deleted or crossed out.
- D. Certified arrangement drawings, outline dimensions, and weights for all major (engineered) equipment including, but not limited to:
 - 1. Low voltage switchgear.
 - 2. Transformers.
 - 3. Motor control centers.
- E. Functional description or logic diagrams for all control systems furnished under Division 26, Electrical.
- F. Characteristic curves for all protective devices.
- G. Certified drawings and descriptive literature for all equipment and devices furnished under Division 26, Electrical, and not listed above.
- H. Schematic (elementary drawings for any electrical control and bills of material for equipment including, but not limited to:
 - 1. Switchgear
 - 2. Motor control
 - 3. Control systems furnished under Division 26, Electrical.
 - 4. Switchgear, Breakers, and Automatic Controllers

- I. Connection diagrams showing all internal wiring and all required field connections for the following:
 - 1. Low voltage switchboard
 - 2. Breakers
- J. The interconnection diagrams shall show terminal points, intermediate connections, device designation, terminal numbers, polarity of dc circuits, conductor identification, and any other information necessary to show which conductor connects to which point; the Contractor shall review and sign off on the control interconnection diagrams.
- K. In addition to submittals for specific items mentioned above, furnish shop drawing information on the following items:
 - 1. Conduit, tubing, and fittings.
 - 2. Wireway.
 - 3. Outlet and device boxes.
 - 4. Pull boxes and junction boxes.
 - 5. Terminal junction boxes.
 - 6. Manholes and handholes.
 - 7. 600-volt conductors.
 - 8. Control cable.
 - 9. Receptacles.
 - 10. Surge suppressors
- L. Electrical Systems Analyses
 - 1. Obtain a Short Circuit Study coordination study of the new and modified existing electrical distribution system. Include all calculations, selected equipment and devices, and recommended settings. The study is to encompass all devices from the utility connection and on-site generator to the largest motor or load on each MCC or distribution panel.
 - 2. Obtain a Relay Coordination Study of the new and modified existing electrical distribution system. Study shall determine the proper setpoints for all L/S/I/G circuit breakers as shown on the drawings and/or located at the facility. Contractor shall set breakers accordingly.
 - 3. Obtain an Arc Flash Hazard Analysis Study for the new and modified electrical distribution system. Study shall be performed per the requirements set forth in the latest edition of the NFPA 70E - Standard for Electrical Safety in the Workplace. The Arc-Flash Hazard Analysis shall be provided for all equipment as stated in NFPA 70E and listed in this specification.
 - 4. Provide arc flash labels for all electrical new equipment such as switchboards, panelboards, industrial control panels, meter sock enclosures, motor control centers,

- 480V disconnect switches, motor starter panels, variable frequency drives, manufacturer's control panels, and any other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized.
5. Labels shall be in accordance with the latest version of NFPA 70E and shall be approved by the Owner/Engineer prior to production.
 6. Contractor shall print and install all arc flash labels based upon study.
 7. All studies shall be done by an independent Professional Engineering Company licensed to practice in the State of South Carolina and licensed to do work in the City of Laurens, SC. Company shall have five years of experience with similar analysis and similar project.
 8. Provide a written report consisting of the following:
 - a. Short Circuit Study
 - b. Relay Coordination Study
 - c. Setpoints of ALL adjustable circuit breakers
 - d. Arc Flash Hazard Analysis
 - e. Include all labels
 - f. List of deficiencies and recommendations
 9. The study shall be done using the following software: SKM System Analysis or etap.
 10. Provide one eight-hour training day for the Owner employees and any owner representatives. Training day shall be scheduled 30 days in advanced and be done at the Comission Office - Training Center. During training session, contractor shall provide Owner a USB stick containing the SKM or etap files of the studies.

PART 3 - EXECUTION

3.01 WIRING ELECTRICALLY OPERATED EQUIPMENT

- A. The Contractor shall be responsible for electrical connections to all equipment requiring electrical power. This responsibility applies to equipment furnished under this and other Divisions and by the Owner.

3.02 RECORD AND AS-BUILT DOCUMENTS

- A. Maintain at the job site a set of Contract Documents kept current by indicating thereon all changes, revisions and substitutions, between work as specified and as installed.
- B. Furnish Owner with complete set of Operation and Maintenance Manuals.

3.03 EQUIPMENT OPERATION

- A. This Division is responsible for: (1) proper rotation, (2) observing that lubrication has been properly performed, (3) that motors operate within nameplate limits, and (4) adjustment of circuit breaker and MCP trip settings.
- 3.04 CLEANING AND PAINTING
- A. Fixtures, panels and equipment shall be thoroughly cleaned. All equipment shall be touched up or repainted as required to present a clean professional appearance. Paint all ferrous metal that is not otherwise protected against corrosion. Paint exposed pipe threads with Bitumastic No. 50.
- 3.05 IDENTIFICATION
- A. Identify all major items of equipment including controls, panels, switches, contactors, motor starters, junction boxes and metering by permanent nameplates, with wording approved by Engineer. Secure metal nameplate frame with screws or brads. Adhesives are acceptable on components within NEMA 1 enclosures.
 - B. Each receptacle and light switch shall be identified with panelboard and circuit designation.
 - C. Nameplates after installation shall be easily visible and shall bear notations corresponding to those shown on record drawings.
 - D. Each instrument shall be identified with a stamped stainless steel tag system (Brady or approved equal). Instrument tags shall be permanently attached to each individual instrument and stamped with the appropriate number per instrument specification section.
 - E. Each cable shall be identified with a permanent labeling system (Brady Catalog Number B-292 with printed legends or approved equal). Instrumentation cables shall be labeled with the appropriate instrument number of the originating signal (Ex. FT-2020-1). Multiplex cables, power and control cables shall be labeled with the appropriate cable number per the conduit and cable schedules. Refer to PICS shop drawings for instrument cable identification.
 - F. All switchgears, MCC's, MCC compartments, power panels, lighting panels, control panels, control cabinets, etc. shall be identified with permanently mounted phenolic labels.
 - G. All power and lighting panels shall have typed schedules mounted on panel doors.
 - H. All terminals and associated wires shall be numbered and labeled respectively, and wiring diagrams shall be installed in the MCC or electrical panel doors.
- 3.06 TEST PERIOD
- A. Each piece of equipment shall continue to meet performance specifications throughout the first year of operation. Contractor shall replace or repair any defect due to faulty workmanship or material which shall develop within 1 year from date of acceptance.
 - B. For first year after final acceptance, Contractor shall provide, at no cost to Owner, any required maintenance and service necessary to assure the proper operation of the system. Date of acceptance shall be certified by Engineer as that date on which the Contract Work has been satisfactorily completed, as a whole, in accordance with the Contract Documents.

3.07 GROUNDING

- A. See Specification 26 05 26.

3.08 ELECTRICAL TESTING AND START-UP

A. General

1. Prior to energizing any equipment, the electrical contractor shall thoroughly vacuum clean the equipment with an industrial type vacuum cleaner. The outside of all electrical equipment shall be cleaned and paint touched up as required to leave equipment in an "as purchased" condition.
2. During start-up of new equipment, the electrical contractor shall provide sufficient personnel to aid with start-up of the electrical equipment to remove any faults, and to make the necessary adjustment for proper operation of electrical equipment and installation. This includes sufficient personnel to aid equipment service personnel in their check-out of the electrical equipment and service.
3. All testing equipment shall be furnished by the Contractor.
4. All failures under tests due to defective material or poor workmanship shall be corrected by the Contractor at no expense to the Owner.
5. The electrical contractor shall not, under any circumstances, energize any electrical equipment covered by these Specifications without first obtaining permission from the Engineer.

B. Grounding

1. After all connections have been made to the ground, ground tests shall be made to verify its adequacy. See specification 26 05 26.

- C. Typewritten directories shall be inserted in all panels showing the designation of each circuit. All power and replacement fuses necessary for testing shall be furnished and paid for under this item.

D. Circuit Continuity

1. Complete installation shall be free of short circuits, open circuits, and other defects. Insulation Resistance and Continuity Tests shall be performed in accordance with Section 26 01 26-3.2 to prove that all parts of the installation are intact.

3.09 INSTALLATION OF EQUIPMENT

- A. The electrical contractor shall coordinate with the Local Utility Company, Contractor and Owner in order to have electric power available when required.

3.10 TEMPORARY ELECTRIC POWER

- A. The contractor shall coordinate, furnish, pay for, and provide any necessary provisions for electric power used during construction.

END OF SECTION

SECTION 26 01 26

FIELD INSPECTION AND ACCEPTANCE TESTS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. After electrical installation is complete, perform tests to demonstrate that entire system is in proper working order and in accordance with applicable codes, manufacturer's instructions, drawings and specifications. Tests are in addition to, and no substitution for, tests of individual items at manufacturer's plant. Perform insulation and ground resistance tests before operating tests. Determine proper rotation of motors before permanent connections are made.
- B. Tests are also intended to provide, ensure, or determine the following:
 - 1. Provide initial acceptance tests and recorded data that can be used as a bench mark for future routine maintenance and trouble shooting by plant operating forces.
 - 2. Ensure a successful start-up with a minimum of last minute interruptions and problems.
 - 3. Determine the suitability of the equipment and systems for energization and placing into operating service.
 - 4. Provide assurance that each system component is not only installed satisfactorily but performs, and will continue to perform, its function in the system with reasonable reliability throughout the life of the plant.
- C. It is the Contractors responsibility to provide all supervision and labor, materials, tools, test instruments or other equipment or services and expenses required to test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry throughout the installation. Also, the Contractor shall include the furnishing of sufficient personnel to assist operating forces in any additional checks they may require for acceptance, start-up, run-in and placing the equipment and systems into continuous service.
- D. The Contractor shall engage the services of a competent nationally recognized independent electrical equipment testing laboratory or organization to perform part of the required field inspections, tests, and adjustments specified. The testing firm shall not be a subsidiary, division, nor department of either the installing Contractor or the manufacturer of the equipment materials or systems being inspected and tested. The testing firm shall be a fully accredited member of the International Electrical Testing Association, Incorporated (NETA) and have the specialized experience and skill in the supervision and performance of all inspection and testing specified herein. The Contractor to submit proof of the proposed testing firm's qualifications, accreditation, and experience for evaluation and approval by the Engineers and Owner.

- E. The Contractor's engagement of the testing firm shall perform tests near the start-up and completion of the facilities in no way relieves the Contractor of the responsibility for the performance of the many and varied tests, check outs, and inspections required during the various stages of construction.
- F. The listings and descriptions of the tests, and checks described herein shall not be considered as complete and all inclusive. Additional normal standard construction (and sometimes repetitive) checks and tests may be necessary throughout the job, prior to final acceptance by the Owner.
- G. Pay all costs for tests including expenses incident to retests occasioned by defects and failures of equipment to meet specifications.
 - 1. Replace wiring and equipment found defective, or failing to meet specified requirements, without charge, unless written acceptance for repair is given by Engineer.
 - 2. Furnish four copies of all test results to Engineer.
 - 3. Unless otherwise specified, Owner will supply electric current necessary for tests.

1.02 REFERENCES:

- H. All inspections and tests shall be in accordance with the following applicable codes and standards latest revisions except as provided otherwise herein.
 - 1. All Standard, Special and Supplemental Conditions of the Contract.
 - 2. National Electrical Manufacturer's Association - NEMA
 - 3. American Society for Testing and Materials - ASTM
 - 4. Institute of Electrical and Electronic Engineers -IEEE
 - 5. International Electrical Testing Association - NETA
 - 6. American National Standards Institute - ANSI:
 - a. ANSI C2: National Electrical Safety Code
 - b. ANSI Z244-1: American National Standard for Personnel Protection
 - 7. State and Local Codes and Ordinances
 - 8. Insulated Cable Engineers Association - ICEA
 - 9. Association of Edison Illuminating Companies - AEIC
 - 10. Occupational Safety and Health Administration:
 - a. OSHA Part 1910; Subpart S, 1910.308
 - b. OSHA Part 1926; Subpart V, 1926.950 through 1926.960

11. National Fire Protection Association - NFPA:

- a. ANSI/NFPA 70B: Electrical Equipment Maintenance
- b. NFPA 70E: Electrical Safety Requirements for Employer Workplaces
- c. ANSI/NFPA 70: National Electrical Code
- d. ANSI/NFPA 780: Lightning Protection Code
- e. ANSI/NFPA 101: Life Safety Code

I. All inspections and tests shall utilize the following references:

- 1. Project Design Specifications
- 2. Project Design Drawings
- 3. Manufacturer's instruction manuals applicable to each particular apparatus

1.02 SCHEDULING:

- A. The Contractor shall be responsible for the preparation of proposed procedures and schedules for all inspections, tests, settings and calibrations specified or otherwise required prior to or during the check out for start-up and acceptance of all the electrical components, equipment and systems. This work shall be coordinated and to be compatible with both the work of other crafts and the project schedule. All inspections and tests procedures must be organized and submitted with all proposed testing and check out forms for the review and approval of the Owner's Representative. The procedures shall provide specific instructions for the checking and testing of each component in addition to the system functional checks. Tests and inspections shall be scheduled as the job progresses and may require repetition in grater detail at a later stage of construction. All procedures submitted shall include job safety rules proposed.
- B. Equipment purchased by the Contractor shall be inspected and tested by the independent testing company to determine its condition. See other applicable sections of the specifications and contract documents for required Contractor checks and responsibilities.
- C. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty, or requiring repairs shall be reported to the Owner's Representative. Corrective action may require prior approval.
- D. Prior to check out and testing for start-up, the Contractor shall ensure that all equipment and wiring is properly and permanently identified with nameplates and other identification as specified elsewhere. The Contractor shall check and tighten all terminals and connection points, remove all shipping blocks and hardware, thoroughly clean all equipment, repair all damaged or scratched finishes, inspect for broken and missing parts and review and collect manufacturer's drawings and instructions for delivery to the Owner's Representative. The Contractor shall make routine checks and tests as the job progresses and as necessary to insure that all wiring and equipment is properly installed and wired.
- E. All testing and checkout work shall be performed with fully qualified personnel skilled in the particular tests being conducted. This is essential for obtaining and properly evaluating data

while the tests are in progress and for insuring that important facts and questionable data are reported.

- F. All inspections, tests, and calibrations shall be reported in writing on Owner/Engineer-approved reports forms as submitted in section 1.03-A of this specification. The recorded data form shall have the signatures of the persons conducting the tests, authorized witnesses, and the Owner's Representative. The forms shall be designed to serve as the test and inspection checklist for inspection requirements. "As-found" and "as-left" test data shall be recorded and reported in writing.
- G. The sequence of all tests and checks shall be such that the equipment can be energized immediately after the completion of the applicable tests.
- H. When applicable electrical tests and inspections specified herein, or otherwise required are completed and results reported and reviewed then the Contractor may consider that portion of the electrical equipment system or installation electrically complete. The Contractor shall then affix appropriate dated completion or calibration labels to the tested equipment. The Contractor shall notify the Owner's Representative of electrical completion. If the Owner's Representative finds completed work unacceptable, he will notify the Contractor in writing of the unfinished or deficient work shall be corrected by the Contractor. The Contractor shall notify the Owner's Representative in writing when all exceptions have been corrected. A "Notification Of Substantial Electrical Completion" shall be prepared following satisfactory compliance. If later in-service operation or further testing determines problems attributable to the Contractor, these shall be corrected by the Contractor or suitable arrangements shall be made to suit operating circumstances.

PART 2 - PRODUCTS

2.01 TESTING EQUIPMENT:

A. Calibration:

- 1. The Contractor shall furnish all the material, test equipment, and power sources required for testing, calibrating and check out. All calibration and setting checks by the independent testing laboratory shall be performed with the laboratory's calibrated test instruments of appropriate accuracy. This test equipment shall have calibrations traceable to the National Bureau of Standards. Contractor and/or testing laboratory dated calibration labels shall be visible on all test equipment. Calibrations over 6 months old will not be acceptable on field test instruments. The accuracy of all test instruments shall be at least twice that of the accuracy of the equipment, device, relay or meter under test. All testing instruments shall be checked to insure satisfactory operation prior to proceeding with the tests. Serial and model numbers of the instruments used shall be recorded on the test forms.
- 2. Make necessary openings in circuits for testing instruments and place and connect all instruments, equipment, and devices, necessary for the tests. Upon completion of tests, remove instruments and instrument connections and restore all circuits to permanent condition.

2.02 TESTING:

A. Coordination:

1. Coordinate activities, and cooperate with others on project, to ensure that systems are energized when required, loads applied, and other requirements of Section are carried out on timely, coordinated basis.
2. Conduct tests in presence of Engineer. Notify Engineer seven calendar days or more in advance when any test to be performed, and do not start tests without Engineer's permission.
3. Other Sections of specifications require services of one or more manufacturer's representatives, to ensure that equipment supplied has been installed properly and adjusted to proper working order. Advise representative of all applicable tests in this Section, so that work will be coordinated, and tests combined where feasible.
4. It is important that equipment warranties or guarantees not be voided by the Contractor's testing and checkout work. The checks and tests to normally be supplemental to and compatible with the manufacturer's installation instruction leaflets and literature. Where deviations are apparent, the manufacturer's review shall be obtained prior to testing. Reasonable cooperation shall be extended to permit witnessing by the manufacturer's representative if so requested. Where any questionable repairs, modifications, significant adjustments, tests or checks are to be made, the Contractor to contact the Owner's Representative to determine if the work should be performed by or with manufacturer's representative.

B. Preparation:

1. Make up no high and/or medium-voltage connections at service entrance, transformers, substations, motors, medium voltage motor control centers, switchgear and generator permanently until correct phase rotation of all equipment is determined. Install and insulate these connections temporarily, if necessary, while determining proper rotation. Make permanent connections after proper rotation has been established and subsequent to completion of insulation resistance and dielectric tests.

PART 3 - EXECUTION

3.01 INSULATION TESTS OF EQUIPMENT, CABLE, AND CIRCUITS:

A. General:

1. The Contractor shall perform, or have performed by the independent testing firm, DC insulation tests of the type specified on electrical equipment, apparatus and cables under any one or more of the conditions described as follows: At the time equipment such as motors, generators, transformers, power circuit breakers and switches, switchgear, motor control centers, bus duct, and similar electrical equipment is : (1) delivered to the Contractor for care, storage, and/or installation, (2) prior to energization and/or placing into service and acceptance by the Owner, (3) when damage to the insulation is suspected or known to exist, (4) after repairs or

modifications to the equipment affecting the insulation, (5) routinely as necessary to determine or evaluate the condition of the insulation, especially moisture conditions, to determine the need for drying, cleaning or other maintenance work or protection, (6) where lightning or other surge conditions are known to have existed on the circuit.

2. DC insulation testing at voltages greater than 2,500 volts on any equipment or cable is reserved for testing by the independent testing laboratory.
3. Insulation tests are required to be done by the Contractor or the independent testing firm at various stages of construction. The equipment, cable and systems that require testing, the maximum test voltages, and the type tests required shall be in accordance with NETA STD.ATS, and Paragraphs 3.02 and 3.03 under specific equipment type.
4. List each circuit and measured resistance as test data.
5. Maintain record of all insulation resistance values. Identify conductor, or equipment, date that value was taken and resistance value. Arrange information in suitable neat tabular form and turn to Engineer.

3.02 SPECIFIC TESTS AND INSPECTIONS BY THE CONTRACTOR:

A. General:

1. The following specific items of work shall be performed by the Contractor. The list is not all inclusive, nor does it define how the tests and checks are to be made. It is merely to define the minimum and type of tests that are required. The equipment and cable shall be deenergized and isolated as necessary to perform the tests.
2. It should be stated again that the engagement of the independent testing firm in no way relieves the Contractor of the responsibility for, or diminishes the importance of, performance tests, checkouts, and inspections during the various stages of construction. The specific work of the independent test firm is defined in Paragraph 3.03.
3. The Contractor shall perform tests and inspections as defined in the other sections of this specification. Tests and inspections required by these sections are not necessarily repeated under specific equipment in Paragraph 3.02
4. All equipment received for the job and for which the Contractor is responsible to be stored and cared for per the manufacturer's instructions. It is the Contractor's responsibility to obtain such information even where the instructions are not shipped with the equipment.
5. The Contractor shall assist the independent test laboratory in performing its work.

B. Equipment Test and Inspection During Construction and Prior to Acceptance Testing:

1. Motors:
 - a. At the time of motor receipt, each motor shall be visually inspected for any physical damage and the motor meggered.
 - b. All voltage motors shall be provided with adequate heating during storage.

- c. Before energizing any machine, visually inspect for serviceability. Check manufacturer's instruction manual for correct lubrication and ventilation. Verify that proper alignment has been performed. Check nameplate for electrical power requirements.
 - d. Test run all motors preferably uncoupled or unloaded, before placing into regular service. A check on the motor for rotation, speed, current and temperature rise to be made and results recorded. The proper color codes for phase identifications to be maintained. This may require lead swaps at the motor for proper rotation. A motor phase rotation meter shall be used prior to connection at motor to prevent later swaps.
 - e. Complete visual inspection and electrical test per NETA STD. Section 8.15.1
2. Medium Voltage Switchgear, Medium Voltage Control Centers and Medium Voltage Switches:
- a. At the time of equipment receipt, the exterior shall be visually checked for any damage and the interior checked for damaged or loose components. Insulators to be carefully checked.
 - b. Prior to connecting cable leads to the equipment, the internal bus bars and power connection to have a 25,000 volt megger test. If moisture is a problem, the gear may have to be dried out before going into service. If the insulation resistance between conductors and ground reads below 50 megohms with the breakers out, moisture, dirt or other contaminants may be a problem.
 - c. Cable phasing and identification to be checked prior to connecting cable leads.
 - d. Contractor shall check to insure proper fuse sizes and settings of overload elements or relays in control centers.
 - e. Prior to final checkout by the independent testing laboratory, physically and functionally check all control circuits and devices and key, mechanical, and/or electrical interlock system. Alignment of circuit breaker elements or motor controllers with fixed connections in cubicles to be checked for ease of insertion and withdrawal.
 - f. Motor controllers, medium voltage switches, and disconnects shall be checked for proper fuse sizes and types and the information recorded and properly reported on the forms.
 - g. The Contractor shall check all bolted bus joints and all other power and control terminal connections. Calibrated torque wrench methods in accordance with manufacturer's instructions to be used on bus connections or where needed.
 - h. Complete inspection and electrical tests requirements per NETA STD:
 - 1) Section 8.1 – Motor Control Center
 - a) Section 8.5 - Switches
 - b) Section 8.6 - Circuit Breakers

- c) Section 8.19 - Surge Arresters
 - d) Section 8.10 - Instrument Transformers
- i. Grounding Systems:
 - 1) All main plant building loops and major equipment grounds shall be tested to remote earth or directly referenced to an extremely low resistance (approximately 1 ohm) reference ground bench mark. Visual inspection of all systems, raceway and equipment grounds shall be made to determine the adequacy and integrity of the grounding. All ground testing results shall be properly recorded, witnessed, and reported to the Owner's Representative.
 - 2) Test each ground rod and submit tabulation of results to Engineer. Include identification of electrode, date of reading and ground resistance value in results.
 - 3) Test each entire grounding system for continuity of connections and for resistance. Ensure that ground resistance of conduits, equipment cases, and supporting frames does not vary appreciably from that of system as whole and does not exceed 5 Ohms.
 - 4) Where ground test results indicate the need for additional grounding conductors or rods that are not indicated on drawings or specified, design changes will be initiated to obtain the acceptable values. The Contractor shall be responsible for the proper installation of the grounding shown on drawings or specified and for the correction of improper installations as determined by inspections and tests.
- 3. Power Transformers:
 - a. At the time of equipment receipt, the exterior to be visually checked for any damage or any defects.
 - b. Perform complete inspection and electrical tests in accordance with NETA STD, Section 8.2.
- 4. Low Voltage Switchgear: Refer to Paragraph 8.2. Perform all applicable tests and checks as described in Paragraph 8.2.
- 5. Protective Relays and Metering:
 - a. Prior to final check out as described in Paragraph 3.03, visually inspect and correct, where appropriate, all relays, meters, wiring and related circuitry for tightness of connections, physical damage, compliance with specifications and Vendor data, mechanical condition, freedom of movement, and presence of or possibility of moisture, dust, or other contaminants.
 - b. Clean, check, and pre-set all protective relays. (Final calibration and adjustment, etc., shall be by the independent testing laboratory. Refer to Paragraph 3.03)

- c. Complete inspection and electrical tests per NETA STD. Section 8.9
- 6. Low Voltage Motor Control Centers:
 - a. At the time of equipment receipt, the motor control centers shall be visually checked for any damage.
 - b. Perform inspection checks and electrical tests in accordance with NETA STD. Section 8.16.2.
 - c. Bus Ducts:
 - 1) At time of equipment receipt, the exterior and bus work shall be visually inspected for any damage.
 - 2) Perform inspection checks and electrical tests in accordance with NETA STD. Section 8.4.
- C. Service Transformers:
 - 1. All 480 volt primary, air-cooled, transformers shall be given an insulation test, by means of a megger, after connections with the primary cables are complete. The supply cable shall be meggered with the primary winding and to the open air circuit breaker. Secondary leads may be meggered with the secondary windings to the open load breakers.
 - 2. Continuity and correctness of connections of all windings, and ratings shall be checked.
 - 3. Perform inspection checks, and electrical tests in accordance with NETA STD Section 8.2.3.
- D. Wire and Cable:
 - 1. Before energizing, the continuity and insulation resistance of every circuit external to equipment shall be measured with a megger from each wire to all others and ground. Tests shall normally be conducted at voltages 500 volts or lower. High potential testing will normally be performed by the independent testing laboratory as described in Paragraph 3.03.
 - 2. Insulation resistance measurements shall be taken of the following: (Refer to Paragraph 3.01 for additional information.)
 - a. Motor Feeders: With motors disconnected, measure insulation resistance from load side of contactors or circuit breakers. Repeat this test after motors are connected and just before energizing at perhaps lower voltage as limited by the maximum test voltage for the motor.
 - b. Motor Control Circuits (600 Volts): With push buttons and overcurrent devices connected, measure insulation resistance from phase to ground only. It will be necessary to lift the neutral ground on the control transformers to perform this test. Also, isolate any control elements that should not be meggered.

- c. Lighting Panel Feeders: Measure insulation resistance with circuit breakers, lighting transformers and panelboards connected, but with lighting branch circuit breakers or switches open.
 - d. Lighting Branch Circuits: Measure insulation resistance after all lampholders, receptacles, fixtures, etc., are connected but before lamping.
 - e. Feeder Circuits: Measure insulation resistance with connections to circuit breakers made up but with breakers open and loads not connected.
3. All cables and wires shall be checked for proper identification numbering and/or color coding.

E. Overhead Conduit Systems:

1. The overhead conduit system shall be checked for proper installation by using the following check list: (This list not to be considered all inclusive but as a guide for inspection).

Conduits are supported on appropriate independent supports (i.e., not on process piping, pipe ways, or piping hangers).

- a. Exposed conduits are run in a neat workmanlike manner, parallel or perpendicular to structural members.
- b. Conduits are routed as far away from possible fire hazards and heat sources as practical.
- c. Conduits are supported at the required intervals.
- d. Pull boxes and fittings are installed so that covers are easily removable. Verify that all covers are installed and tightly bolted with gaskets provided where needed.
- e. Number of bends in the conduit does not exceed 270 degrees without a pull box installed.
- f. Circular cross sectional area is uniform at conduit bends. Single bends do not exceed 90 degrees.
- g. Conduits are terminated in threaded hubs or bushings to prevent damage to wire.
- h. Conduits joints have joint compound of the type specified and are tight and conduit ends are properly reamed and threaded not to engage less than 5 threads.
- i. Pull fittings are of adequate size such that cable can be installed and replaced at a later date without bending the cable less than code or manufacturer's requirements.
- j. Seal fittings and/or sealing compound is installed at moisture barriers to prevent entry of moisture into equipment and/or where shown on plans.

- k. Drains and conduit seals are installed on vertical conduit runs entering devices, equipment, and enclosures to prevent entrance of moisture.
- l. Flexible conduit is installed at motors and other equipment as specified or required. Verify that all cabling and conduit runs are properly identified at each end.

F. Underground Conduit Systems:

- 1. Underground conduit systems shall be inspected and checked for compliance with standard practices, plans and specifications as the job progresses.
- 2. Upon construction completion of the underground conduit banks or runs and prior to backfill, the routing and the elevation and depth below grade shall be checked and any deviations from plans and/or specification to be recorded and in addition noted on "as-built" plans.

G. Relay Panels, Operator and Instrument Control Panels, Communications Systems, Static Equipment, Programmable Controllers, Micro-Processors, Battery Systems and Other Miscellaneous Equipment:

- 1. Upon receipt of equipment, each item shall be inspected for damage, loose or missing parts.
- 2. Upon completion of equipment installation, all equipment and their control devices shall be visually and functionally tested for tightness of connections and for proper operation. In the case of battery systems, static inverters and the like, manufacturer's recommended test and installation manuals shall be reviewed and complied with. In the case of operator, instrument, and relay panels and cabinets or devices used solely for control, each circuit, where possible, shall be functionally tested for proper operation and conformance with drawings. Where functional testing is deemed undesirable by the Owner's Representative from a safety or plant operational standpoint, then continuity and terminal connection verification checks will be adequate. The Contractor shall insure that instruments and associated components cannot be energized until instructed by the Owner's Representative. For functional, operational, and calibration checks of instrument loops, refer to the instrument installation specifications.
- 3. Panelboard electrical checks shall be as included in the Wire and Cable section of this specification, 3.02-E. Panelboards to be checked for proper circuit identification on the door schedule.

H. Sealing of Openings: The Contractor shall inspect the entire job with the Owner's Representative to insure that all openings and holes that the Contractor provided or utilized are properly sealed as specified elsewhere.

I. Record Drawings: The Contractor shall maintain a master set or record drawings that shows changes and any other deviations from the base drawing. The markups shall be made as the changes are done. At the conclusions of the job, these master record drawings shall be complete and delivered to the Owner's Representative for forwarding to the design group.

3.03 CONTRACT CLOSEOUT:

A. Provide in accordance with Section 017000.

END OF SECTION

SECTION 26 05 00

ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all labor, equipment and materials required to complete the installation specified herein, and shown or scheduled on the Drawings. Since the drawings are schematic, all fittings, connectors, etc. are not shown, but shall be furnished as required for a complete and functional installation.

1.02 QUALITY ASSURANCE

- A. Where not otherwise specified, all material and methods shall be of the highest industrial quality suitable for the application. All panelboards, motor starters, transformers, and other electrical equipment that is stored prior to installation, or that is installed outdoors, shall be protected from corrosion and rust with a product equal to Zerust Vapor Capsules or Cutler-Hammer Oxidation Inhibitor Capsules.

1.03 SHOP DRAWINGS

- A. Shop Drawings are required for the following items: Safety Switches, Motor Control Centers, Wire, Manholes, Handholes and Covers, Starters, Circuit Breakers, Lighting Fixtures and Poles. A list of product manufacturers is required for all other items covered by these Specifications.

PART 2 - PRODUCTS

2.01 HAZARDOUS AREAS

- A. Provide devices, materials, and equipment for installation in hazardous areas that are specifically approved for installation in hazardous areas of the Class, Division and Group indicated, and are of construction that will ensure safe performance under conditions of proper use and maintenance. Provide devices, materials, and equipment meeting the requirements of the 2011 NEC with 2009 Georgia Amendments, applicable state and local codes, and the authority enforcing these codes. Acceptable manufacturers: Crouse Hinds, or Appleton.

2.02 MATERIALS

A. Conduits

1. See section entitled "Conduits" of these Specifications.

B. Wires and Cables

1. See section entitled "Wire and Cable" of these Specifications.

C. BOXES AND WIREWAYS

1. **OUTLET BOXES:** Galvanized sheet steel per UL 514. "Through-wall" boxes SHALL NOT BE USED. Back-to-back mounting of boxes is not permitted. All outlet boxes 4"x4" or smaller located on opposite sides of a rated wall shall have a minimum of 24" horizontal spacing or shall be protected with listed putty pads. All outlet boxes larger than 4"x4" (communications outlets, etc.) located in rated walls shall be protected with listed putty pads.
2. Box sizes shall be as follows:
 - a. Wall Receptacle Outlets: 4" square by 2 1/8" deep with plaster ring as required.
 - b. Wall Communications and Computer Outlets: 4 11/16" square by 2 1/8" deep with one gang plaster ring. Provide box with 1 1/4" conduit knockouts.
 - c. TV Wall Outlets: 4 11/16" square by 2 1/8" deep with one gang plaster ring. Provide box with 1 1/4" conduit knockouts.
 - d. Ceiling outlets: 4" square or octagonal by 1 1/2" or 2 1/8" deep with stud or ears where required for fixture support.
 - e. Indoor Surface Mounted Outlets: Wiremold V5744S-2 surface metal box unless noted otherwise on the drawings (steel boxes and EMT conduit may be used in equipment rooms, janitor's closets, storage rooms).
 - f. Exposed Outlets: Malleable iron or heavy duty cast aluminum with threaded hubs, Type FS, FD, or GS. Manufactured by Crouse Hinds, Appleton, Killark, or approved equal. Die cast boxes are not acceptable.
3. **SUPPORT FOR RECESSED BOXES IN MASONRY WALLS:** Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
4. **SUPPORT FOR RECESSED BOXES IN STUD WALLS:** Support boxes from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose. Box brackets reliant on support legs pressed against back of opposing wall are not acceptable.
5. **WIREWAYS, PULL BOXES AND JUNCTION BOXES:** UL 50. Code gage galvanized sheet steel, aluminum, or steel primed and painted after fabrication. Manufactured by Square D, Austin Berryhill, Hoffman Engineering, B-Line Systems, or approved equal. Wireways shall have hinged covers.

D. WIRING DEVICES

1. **MANUFACTURERS:** All wiring devices shall be Hubbell Extra Heavy-Duty Specification Grade Series or equivalent of Arrow Hart Premium Industrial Spec Grade, Pass and Seymour Industrial Extra Heavy-Duty Spec Grade, or Leviton Industrial Spec Grade, unless specifically noted otherwise. If devices not meeting the specifications are supplied, they shall be removed, discarded, and new devices meeting the specification shall be furnished & installed by the Electrical Contractor at no cost to the Owner or the Engineer.
2. **RECEPTACLES:** 20A, 125V, 3 wire grounding, NEMA 5-20R, side and back wired, with impact resistant nylon face and standard color as selected by Architect.

- a. "TR" denotes Tamper-Resistant receptacle. Tamper Resistant receptacles shall be listed Tamper-Resistant receptacles per NEC Article 406.11, typical for receptacles in Dwelling Units, Kindergartens, and Childcare Areas.
 - b. "CR" denotes indoor Corrosion Resistant receptacle. Indoor Corrosion Resistant receptacles shall be listed Weather/Corrosion Resistant receptacles per NEC Article 406.8.
 - c. "WR" denotes weather-resistant receptacle. Weather-resistant receptacles shall be listed Weather/Corrosion Resistant receptacles per NEC Article 406.8 and shall include a standard flat wet location cover.
 - d. "WP" denotes weatherproof receptacle. Weatherproof receptacles shall be listed Weather/Corrosion Resistant receptacles per NEC Article 406.8 and shall include an "In-Use" style wet location cover.
 - 1) Duplex Receptacle: Hubbell HBL-5362-X
 - 2) Duplex Receptacle, Tamper Resistant (NEC 406.11): Hubbell HBL-5362-X-TR
 - 3) Duplex Receptacle, Corrosion Resistant (NEC 406.8): Hubbell HBL-5362-X-WR
 - 4) Single Receptacle: Hubbell HBL-5361-X
 - 5) Isolated Ground Duplex Receptacle: Hubbell IG-5362-X
 - e. GFCI RECEPTACLES: Feed Thru type, 20A, 125V, NEMA 5-20R, standard color as selected by Architect. All GFCI Receptacles shall be listed Tamper Resistant (NEC 406.11) and Weather Resistant (NEC 406.8).
 - 1) GFCI Duplex Receptacle: Hubbell GFR-5362-X-TR
 - 2) Faceless GFCI: Hubbell GFBF20-X-L
3. SWITCHES: 20A, 120/277V, side and back wired, ivory color. Single pole, double pole, three way, or four way, as indicated on the drawings. Standard color as selected by Architect.
- a. Single Pole Switch: Hubbell HBL-1221-X
 - b. Double Pole Switch: Hubbell HBL-1222-X
 - c. Three Way Switch: Hubbell HBL-1223-X
 - d. Four Way Switch: Hubbell HBL-1224-X
4. SPECIAL RECEPTACLES: Specification grade, rating as specified on the drawings.
5. OVER PLATES: Provide plates to suit the devices.
- a. Finished interior walls: Jumbo Stainless Steel.

- 1) Receptacles noted on drawings as dedicated for computers shall include a factory engraved jumbo stainless steel coverplate labeled "COMPUTER". See Electrical Symbols and Power Plans on drawings to identify dedicated computer receptacle.
 - b. Exposed outlets: Galvanized steel.
 - c. Wet locations: Weatherproof "In Use" type for wet location areas, hinged weatherproof type for damp location covered areas.
- E. INTERIOR LIGHTING
- F. FIXTURE SCHEDULE: See drawings.
- G. PRE-PAINTED STEEL: Fixture bodies manufactured from pre-painted steel shall be painted after fabrication, unless noted otherwise on the drawings.
- H. ELECTRONIC FLUORESCENT BALLASTS: As manufactured by Universal Lighting Technologies, or approved equal. See drawings for ballasts specifications. All fluorescent ballast shall include a disconnect plug designed in accordance with NEC 410.73(G).
- I. T8 FLUORESCENT LAMPS: Low Mercury, high CRI, high lumen output, 95% lumen maintenance. Phillips ALTO II Series or approved equal. See drawings for lamp specifications.
- J. LED LAMPS AND DRIVERS: Refer to Lighting Fixture Schedule and Lighting Fixture Schedule
1. Notes on Drawings.
- K. LENSES: Virgin acrylic plastic. Nominal thickness of fluorescent fixture lenses shall be 0.125" unless noted otherwise.
- L. LIGHTING CONTROLS
- M. OCCUPANCY SENSORS: See details and notes on drawings. Occupancy sensors shall be as specified on the drawings, as manufactured by Wattstopper, Sensor Switch (Acuity), Greengate (Cooper), or acceptable equivalent manufacturer. Provide all power packs and mounting hardware necessary to provide a complete and operable system. If a sensor other than that specified is used, furnish and install any additional sensors necessary to provide comparable coverage. Verify spacing requirements with sensor manufacturer and install accordingly. Provide commissioning of occupancy sensors as noted on the drawings.
1. It shall be the Contractor's responsibility to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. It shall be the Contractor's responsibility to make all proper adjustments to assure owner's satisfaction with the occupancy system.
 2. It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owners satisfaction with the occupancy system. This service shall be provided at no additional cost to the owner or the Architect/Engineer.

3. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system. This service is provided at no additional cost to the owner. The Electrical Contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of the system fine tuning the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.
 4. The Contract Documents are diagrammatic and only establish the minimum number and type of sensor required in each space. The Contractor shall furnish additional sensors as necessary to provide the required coverage. The Contractor may not reduce the number of sensors in a space or change the sensor type in a space without written permission from the Engineer and the Owner. In order to provide coverage for the controlled area and accommodate all Owner occupancy requirements, all rooms/spaces shall have between ninety (90) and one hundred (100) percent coverage. Layout of occupancy sensors on the Contract Documents represents the basis of design. The occupancy sensor supplier shall furnish shop drawings and printed material indicating layout of sensors, raceway, and wiring required to control the lighting indicated on the contract drawings. No change order will be allowed for additional sensors, raceway, wiring, power supplies, satellite relays, etc., required on shop drawings by the occupancy sensor supplier. Where power supplies are required for operation of the occupancy sensors, but are not shown on the lighting plans, the power supplies must be included as part of the base bid for this project.
- N. CONTACTORS: Electrically held type, with 120 volt or 277 volt coil (see drawings), Hand-Off-Auto selector switch, and NEMA 1 enclosure. Contactors shall be 30 amp, 4 pole, unless otherwise noted. Manufactured by Square D, General Electric, Eaton, or Siemens. Provide engraved nameplate for each contactor identifying load served.
- O. LINE VOLTAGE PHOTOCELLS: Rated 1800 volt-amps 120V, 208V-277V, or 480V as noted on the drawings, adjustable slide gate, Precision Type "T", or equal of Intermatic, Paragon, or Tork.
- P. LINE VOLTAGE TIME CLOCK: 7-day, 2-channel, 120V electronic programmable time control with two SPDT contacts, NEMA 3R case, 24-hour clock format, leap year correction, and daylight savings time adjustment. Intermatic ET1725CR or equivalent of Tork.
- Q. WALL BOX DIMMERS: Dimmers shall be slide type wall box dimmers with on/off operation, Lutron Nova T series or equivalent of Cooper or Leviton. Dimmer wiring shown on the Drawings is for information purposes only. The Contractor shall verify the dimmer wiring requirements with the dimmer manufacturer prior to start of work and install accordingly. Provide all wiring and power packs required to provide specified dimming and on/off operation, including additional low voltage wiring, whether indicated on the drawings or not.
1. Incandescent Dimmers: Slide-to-off type wall box dimmers with on/off operation, ratings as noted on the drawings. Lutron Nova T NT series, or equivalent.
 2. Magnetic Low Voltage Dimmers: Slide-to-off type wall box dimmers with on/off operation, ratings as noted on the drawings. Lutron Nova T NTLV series, or equivalent.
 3. Electronic Low Voltage Dimmers: Slide-to-off type wall box dimmers with on/off operation, ratings as noted on the drawings. Lutron Nova T NTELV series, or equivalent.

4. 0-10V Fluorescent or LED Dimmers (10% Dimming): Slide-to-off type wall box dimmers with on/off operation. Lutron Nova T NTFTV series with Lutron PP Power Pack for on/off operation, or equivalent.
5. 3-Wire Fluorescent or LED Dimmers (1% Dimming): Slide-to-off type wall box dimmers with on/off operation. Lutron Nova T NTF series, or equivalent.

R. SAFETY SWITCHES AND FUSES

S. SWITCHES: NEMA Standard HD, heavy-duty type, 3 pole, 480 or 240 volt, as indicated, with Class

1. R fuse clips. Manufactured by Square D, General Electric, Eaton, or Siemens. Provide NEMA 4X stainless steel, unless noted otherwise.

T. FUSES: Time delay type, UL Class RK5. Bussman Fusetrons, or approved equal of

U. Chase-Shawmut or General Electric.

1. NAMEPLATE: Provide engraved nameplate for each safety switch identifying load served, voltage, and fed-from identification. Example:

**AHU-1, 480-3-
60**

**FED FROM
HA-15**

V. TRANSFORMERS

W. MANUFACTURERS: Square D, General Electric, Eaton, or Siemens. Dry type transformers manufactured per NEMA standard ST-20, UL 506, UL 1561, ANSI C57.12.91, and ANSI C89.2.

1. Transformers shall be compliant with *DOE 2016 Efficiency* requirements per EPA 2015/10 CFR Part 431 standards, tested according to NEMA TP-2.

X. DESIGN: 150°C rise maximum. 220 C insulation system. TAPS: Four 2.5 per cent, 2 FCAN, 2 FCBN minimum.

Y. NOISE: Sound level shall be tested and comply with ANSI C89.2.

Z. ENCLOSURES: Indoor, ventilated type, unless otherwise noted. Mount transformers 6" off of wall per UL and manufacturer requirements.

AA. PAD: Mount transformer on 6" concrete pad per manufacturer's recommendations. Pad shall extend 4" beyond transformer on all sides. Pad shall have 3/4" chamfer on all sides.

BB. SEISMIC: Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Fasten transformer to pad per the manufacturer's instructions, use vibration pads similar to Cooper Vibra Trol Series.

CC. NAMEPLATE: Provide engraved nameplate for each transformer identifying transformer name, voltage, phase, and fed-from identification. Example:

**XFMR
T-1
480V TO 208/120V,
3PH FED FROM
MSB-14**

DD. Supporting Devices

1. Expansion and/or Deflection Fittings
 - a. O.Z. Gedney, Appleton, Spring City or equal.
2. Channel Support
 - a. Unistrut, Kindorf, Super Strut, or equal. Supports shall be PVC coated galvanized steel or PVC coated aluminum. Uncoated galvanized steel shall not be used. Cut ends of supports shall be recoated with a PVC like coating. Stainless steel, type 316 may be used in lieu of PVC coated supports.
3. Fastening Devices
 - a. Caddy, Appleton, or equal.
4. Cable Ties
 - a. Panduit, Thomas & Betts, or equal.

EE. Seismic Zones

1. All conduit, supports, control panels, gear shall be installed and meet all local seismic zone requirements and meet all state and local codes.

FF. Wall and Floor Seals

1. Wall seals are required for all wall penetrations below grade. Floor seals are not required for slab on grade penetrations but are required for floors below grade. Seals shall be Spring City, O.Z. Gedney, or equal.

GG. Terminal Blocks 0 to 600 Volts

1. Provide 600-volt terminal blocks for termination of all control circuits entering or leaving equipment, panels, or junction boxes. Provide screw clamp compression, dead front barrier-type terminal blocks with current bar providing direct contact with wire between the compression screw and yoke. Provide yoke, current bar and clamping screw constructed of high strength and high conductivity metal. Utilize yoke that guides all strands of wire into the terminal. Utilize yoke that guides all strands of wire into the terminal. Utilize current bar providing dependable vibration proof connection. Supply terminals constructed to allow connection of wire without any special preparation other than stripping. Rail mount individual terminals to create a complete assembly and provide terminals constructed such that jumpers can be installed with no loss of space on terminal or rail.

2. Size all terminal block components to allow insertion of all necessary wire sizes and types. Supply terminal blocks with marking system allowing the use of preprinted or field-marked tags. Supply CSA certified and UL approved terminal blocks.

HH. Magnetic Contactors

1. NEMA ICS 2, UL 508
2. Electrically actuated by dual acting, single-coil mechanism.
3. Inherently interlocked.
4. Main Contacts:
 - a. Power driven in both directions
 - b. Double-break, continuous-duty, rated as shown on the Drawings, to withstand the RMS symmetrical values shown on the drawings.
 - c. Marked for switching of electric discharge lamps and other resistive (non-motor) loads, such as radiant heaters.
 - d. Position not dependent on gravity, hooks, latches, or semi-permanent magnets
 - e. Capable of operating in any position
 - f. Visual indication of each contact
5. Control: As shown on drawings
6. Provide one normally-open and one normally-closed auxiliary contact (for remote indication of status).
7. Enclosure:
 - a. NEMA 250, Type 12, dust-tight, industrial use for dry areas
 - b. NEMA 250, Type 4X for process areas
8. Cutler Hammer, Type CN35, GE, Class 360, or approved equal.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

- A. See section entitled "Conduit" of these Specifications.

3.02 CUTTING AND PATCHING

- A. Provide all cutting and patching required to perform this work.
- B. Do not cut into any major structural element without approval of Engineer.

- C. Patching shall be of quality equal to, and of appearance matching, existing construction.

3.03 EQUIPMENT MOUNTING

- A. Wherever any electrical component, such as panels, raceways, pipes and conduits, will be in contact with surfaces which may become damp or wet, mount using spacers to hold electrical work $\frac{1}{4}$ inch away from damp surfaces.

3.04 PULL-BOXES, TERMINAL JUNCTION BOXES, DISCONNECT SWITCHES AND WIRING DEVICES

- A. Furnish equipment and installation methods in accordance with the following (unless otherwise shown):
 - 1. Indoor Finished Areas (Dry) NEMA 1
 - 2. Indoor Unfinished Areas (Dry) NEMA 12
 - 3. Indoor Wet Areas NEMA 4
 - 4. Indoor Wet and Corrosive Areas NEMA 4X SS
 - 5. Outdoor Areas NEMA 4X SS

END OF SECTION

SECTION 26 05 19

WIRE AND CABLE

PART 1 - GENERAL

1.01 SCOPE

- A. Work covered by this section includes furnishing all labor, equipment, and materials required to install, connect, and test all wire and cable, including splices, terminations, connectors, and accessories for a complete installation as shown on the Drawings and/or specified herein.
- B. The Contractor's attention is directed to the fact that all wires and cables are not necessarily shown on the Drawings, which are more or less schematic. However, the Contractor shall be responsible for furnishing and installing all wire and cable indicated or required to properly connect and place into operation all equipment and services requiring such wiring and/or cable.

1.02 QUALITY ASSURANCE

- A. Samples of all wire and cable, clearly marked and long enough to show complete identification, shall be submitted to the office of the Engineer for approval prior to wiring installation.
- B. No defective or damaged wire and cable shall be incorporated into the work.

1.03 SIZING OF CONDUCTORS

- A. Unless otherwise required or directed by the Engineer, conductors shall be furnished in the sizes shown on the Drawings. No wire for lighting, power, or motor control circuits shall be smaller than No. 12 AWG. Motor control circuits carrying less than 8 amps may be No. 14 AWG. No wire for instrumentation and low-level signal transmission pairs shall be smaller than No. 16 AWG for single pairs or No. 20 AWG for bundled cable.
- B. All wires and cables shall be of such size as to conform to the regulations of the current edition of the National Electrical Code for current carrying capacity.
- C. Where the size of lighting wiring is not given on the Drawings, it shall be of such size that the voltage drop from the main panel to the lighting panel is not more than 1 percent, and the drop in the branch circuit is not more than 2 percent. The voltage drop in motor feeder, when the wire size is not specified, shall not be more than 3 percent at full load from the Motor Control Center to the motor terminal.

1.04 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted in accordance with requirements of the Section 01 33 00 of these Specifications.

1.05 STORAGE AND PROTECTION

- A. Store and protect all wire and cable in accordance with the manufacturer's recommendations and requirements of the Section 01 60 00 of these Specifications.
 - B. Wire and cable shall be stored indoors in a dry and warm location and in its original packaging.
- 1.06 GUARANTEE
- A. Provide a guarantee against defective materials and workmanship in accordance with requirements of the Section 00 72 14 Article 23 of these Specifications.

PART 2 - PRODUCTS

2.01 CONDUCTORS - GENERAL

- A. Conductors shall be solid or Class B concentric stranded, soft or annealed, uncoated copper free from kinks and defects in accordance with ASTM B 3 or B 8.
- B. Copper conductors should have a conductivity not less than 97 percent.
- C. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's "E-Number" permanently marked on the outer covering at not more than 2-foot intervals.
- D. All wires shall conform to the latest Standards of the ASTM and ICEA and shall be tested for their full length by these Standards.
- E. All control circuit wiring and all wiring No. 8 AWG and larger shall be stranded. Lighting branch circuits No. 12 and No. 10 AWG may be solid. Wiring shall be stranded as follows:
 - 1. No. 14 thru No. 2 AWG shall have a minimum of 7 strands.
 - 2. No. 1 thru No. 4/0 AWG shall have a minimum of 19 strands.
 - 3. No. 250 MCM thru No. 500 MCM shall have a minimum of 37 strands.
 - 4. All circuits except control and instrumentation circuits shall have a separate grounding conductor carried in the conduit.

2.02 CONDUCTORS FOR WIRE AND CABLE

- A. XHHW - For service entrance, motor branch, and feeder circuits operating at 208, 240, and 480 volts, the conductors shall be single-conductor, cable rated, 600 volts. The single-conductor cable shall consist of uncoated annealed copper, Class B stranded per ASTM B 8 and insulated with corona, ozone, heat and moisture resisting cross-linked polyethylene insulation rated to withstand a copper temperature of 90 degrees C, Underwriter's approved Type XHHW and shall be as manufactured by Southwire, General Cable Corporation, Okonite Company or equal.
- B. THWN-2 - For general lighting and receptacle branch circuits operating at 120 volts, the conductor shall be single-conductor cable rated 600 volts. The single-conductor cable shall be uncoated annealed copper. No. 12 and No. 10 AWG may be solid, or stranded; larger cables shall be stranded per ASTM B 8 or B 3 and insulated with polyvinyl

chloride insulation rated to withstand a copper temperature of 75 degrees C, Underwriter's approved Type THWN-2, and shall be as manufactured by Southwire, General Cable Corporation, Okonite Company, or equal.

- C. For lighting fixture drop wire or for running in fluorescent units, the conductors shall be single-conductor cable rated 600 volts. The single-conductor cable shall be stranded tinned copper with a 31-mil-thick wall silicone insulation and a glass braid jacket overall rated to withstand a copper temperature of 150 degrees C, Underwriter's approved silicone insulated fixture wire type SFF-2, and shall be as manufactured by General Cable Corporation, General Electric Company, or equal.
- D. For control circuits the conductors may be single or multi-conductor cable rated 600 volts. The conductors shall consist of uncoated annealed copper Class B stranded per ASTM B 3 or B 8 and shall be No. 14 or No. 12 AWG, 7-strand, identified at each end using Brady wire markers B-500 vinyl cloth, Thomas and Betts "E-Z Code" wire markers, or equal.
 - 1. Single-conductor cable shall have 45-mil-thick wall of cross-linked polyethylene or polyvinyl chloride insulation, color red, to withstand a copper temperature of 90 degrees C, Underwriter's Laboratories approved Type RHH-RHW, and shall be as manufactured by General Electric Company, Phelps Dodge, General Cable, Okonite, or equal.
 - 2. Multi-conductor cable shall consist of single-conductor cables rated 600 volts and insulated to withstand a copper temperature of 90 °C cabled together to form a cable assembly which is Underwriter's Laboratories approved for installation in conduit. The core shall be color coded in accordance with ICEA, Method 1, with a plastic tape cover and a PVC or neoprene jacket overall.
- E. Bare grounding conductor shall be Class A or B medium hard drawn, high conductivity bare copper, sized as shown on the Drawings. Conductors No. 6 AWG and smaller may be solid. Conductors No. 4 AWG and larger shall be stranded.
- F. Flexible power cords shall be moisture-resistant, oil-resistant, neoprene-sheathed service cable designed for extra hard usage, Type SO, rated 600 volts at 90 degrees C continuous conductor temperature. Flexible heater cords shall be moisture-resistant, oil-resistant, neoprene and cotton sheathed service cable designed for extra hard usage, Type HSO, rated 600 volts at 90 degrees C continuous. Insulation shall be thermoplastic ethylene-propylene conforming to ICEA S-68-516. Neoprene shall conform to ASTM D 752. All flexible cords shall be UL listed.

2.03 INSTRUMENTATION AND THERMOCOUPLE EXTENSION WIRING

- A. Instrumentation and low level DC signal wiring shall be shielded, twisted pair conductors. Single twisted pairs shall consist of 2, Class B stranded, No. 16 AWG annealed copper conductors, 1 white and 1 black, with 15 mils of PVC insulation rated for 600 volts and 90 degrees C minimum continuous conductor temperature. Pairs shall be twisted to a lay of 1.5 to 2.5 inches. A 0.35 mil by 0.50 mil aluminum-mylar tape shield with stranded, bare No. 18 AWG, tinned copper drain wire in contact with the aluminum side of the shield shall be applied helically around the twisted pair. An overall jacket of 90 degrees C black PVC at least 30 mils in thickness shall be applied to the outside. Shield coverage shall be full 100 percent. All instrumentation wiring shall be UL listed.

- B. Twisted, Shielded Triad Instrumentation Cable for RTD circuits: Stranded copper conductors, size #16 AWG. Insulate conductors individually with color-coded PVC. Provide shield for each triad and tinned-copper drain wire. Provide flame-retardant PVC outer jacket. Cable shall be rated 600 volts and 90 degrees C. Cable shall be designed for noise rejection for use in process control signals.

2.04 AUDIO SIGNAL WIRING

- A. Audio signal wiring for public address and sound systems shall be shielded, twisted pair instrumentation cable with 2 No. 16 AWG conductors constructed in accordance with the requirements of Part 2.3 of this section.

2.05 TELEPHONE AND COMMUNICATION WIRING

- A. Indoor telephone and communication cable shall consist of solid, minimum No. 22 AWG, annealed copper conductors insulated and standard telephone color coded with polyethylene and twisted together in pairs. Pairs shall be cabled together and protected with a metal tape shield and a polyethylene or PVC jacket overall. Cable shall be suitable for installation in ducts.
- B. Buried telephone cable shall be REA approved for aerial installation on messenger wire, installation in underground ducts, and direct burial. Cable shall consist of solid, minimum No. 22 AWG annealed copper conductors insulated and standard telephone color coded with polypropylene or polyethylene and twisted together in pairs. Each pair shall be twisted to a different lay length. Cable with more than 25 pairs shall be assembled from oscillated, bundled, 25-pair subunits. Bundled pairs shall be covered by a nonhygroscopic tape, an inner jacket of polyethylene, a shield of aluminum or tinned copper, and an outer jacket of black, high-molecular weight polyethylene copolymer. Cable core shall be completely filled with a nontoxic, petrolatum-polyethylene weatherproofing compound. Jacket shall be sequentially marked to indicate footage.

2.06 SPLICES AND TERMINATIONS

- A. Splices, taps and attachment of fittings and lugs shall be electrically and mechanically secure, and approved solderless lugs and connectors shall be used. Lugs and connectors shall be top quality product of Burndy, O-Z, Thomas and Betts, or equal manufacturer. Conductors shall not bind at bushings. Lugs shall be of the correct sizes for the conductors joined and strands shall not be cut from a conductor.
- B. Splices, taps, and terminations of cable rated 600 volts and less requiring tape shall be half lap and at least 3 layers. Taping shall be neatly done and form a permanent insulation equal in mechanical and electrical strength to the insulation of the conductor. Taping shall be as follows:
 - 1. Rubber Insulation
 - a. Inner Layer: Okonite Rubber Tape, 3M "Scotchfil" Electrical Insulation Putty, Plymouth "Plysafe" Tape, or equal.
 - b. Outer Layer: 3M "Scotch No. 88" Tape, Permacel No. 295 Tape, Slipknot Grey Tape, or equal.
 - c. Thermoplastic Insulation: 3M "Scotch No. 88" Tape, Permacel No. 295 Tape, Slipknot Grey Tape, or equal.

2. Terminations at motor junction boxes shall be sealed with 3M “Scotchkote” Electrical Coating over the outer layer of tape. All splices 600 volts and less in No. 8 AWG and larger sizes shall be made using approved bolted connectors properly taped as specified herein.
 - C. For No. 10 AWG and smaller branch circuit and fixture conductors operating at 277 volts or less, live spring pressure connectors rated for 600 volts may be used for splices and junctions. When installed in a fixture, connectors shall be rated for 1,000 volts.
- 2.07 GROUND RODS
- A. Ground rods shall be Copperweld, sectional type. Ground rods shall be UL listed and REA approved and shall conform to ANSI C33.8.
 - B. Connections between grounding conductors and grounding rods shall be mechanical if above ground, thermal if underground.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All interconnecting wiring shall be installed in approved conduit or cable trays and connected as shown on the Drawings and/or specified herein. Unless otherwise shown or specified, all wiring shall be run in conduit.
- B. Unless otherwise shown on the Drawings, wiring shall be run by the most direct route keeping overall circuit length to a minimum.
- C. Instrumentation and low level signal wiring shall not be located in the same conduit as motor wiring, feeder wiring, branch circuit wiring, or control wiring. Control wiring shall not be located in the same conduit as feeder wiring, or instrumentation wiring.
- D. All control and circuit wiring in cabinets, boxes, gutters, etc. shall be neatly tied and held using nylon cable ties and mounting brackets.
- E. After installation, conductors shall not have dents, scars, cuts, pressure indentations, abraded areas, etc.
- F. Conductors 600 volts and below shall not be bent to a radius less than 12 times the cable diameter. Conductors above 600 volts shall not be bent to a radius of not less than 24 times the cable diameter.
- G. Wiring run in metallic conduits shall be arranged such that there are an equal number of conductors of each phase in each conduit. Under no circumstances shall metallic conduits contain one single conductor or several conductors of only one phase. This requirement shall not apply to single, bare grounding conductors run in conduit to grounding rods or grids.
- H. Conductors may be coated with talc, soapstone, Ideal “Yellow 77” or “Wire Lube”, Electro-Compound “Y-ER EAS,” or equal, to facilitate pulling into raceways, but in no case may they be greased or coated with any substance injurious to conductor insulation and jacket. Pulling tension shall be exerted primarily on the strongest component of conductors, normally the metallic conductors themselves and not on the insulation jacket.

When installing cable in conduit with pulling eye attached to copper conductor, the tension shall not exceed 0.008 pound per circular mil area of the conductor nor 5,000 pounds, whichever is smaller. When a basket grip is used over the outer jacket of the cable, the maximum pulling tension shall not exceed 0.008 pound per circular mil area of the conductor nor 1,000 pounds, whichever is smaller. In no case shall pulling tensions recommended by the wire manufacturer be exceeded. The maximum sidewall pressure exerted on the insulation and sheath at a cable bend shall not exceed 300 pounds per foot of conduit bending radius. Conductors shall not be pulled "through" any outlet, conduit or box. Separate "pulls" shall be made on each side of such point.

- I. Unless otherwise specified, splices shall be made at outlet or conduit boxes, pull or junction boxes, manholes, or vaults. No splice shall be drawn into a conduit. Splices in wiring rated 600 volts and below shall be made with enough spare wire for 2 splices to be remade with the wire at the same location.
- J. All instrumentation and thermocouple extension wire shields shall be grounded. Shields on individual circuits shall be electrically continuous and shall be grounded at only 1 point in the circuit. Shields on thermocouple extension wire shall be grounded at the thermocouple only.
- K. Surge suppressors shall be installed with the shortest line lead possible, but in no case longer than 18 inches unless otherwise shown on the drawings.
- L. Inside manholes, all cables are to have racks with insulator supports. Supports are to be within 6 inches of each side of a splice and spaced not farther than 3 feet apart.
- M. All conductors are to be identified. Branch circuits, motor feeders, and lightning wiring shall be identified by color coding consistent with the existing facility. If the facility is new, the color code shall be as follows:

N.	O. 277/480V	P. 120/208/240V
Q. Phase A	R. Brown	S. Black
T. Phase B	U. Orange	V. Red
W. Phase C	X. Yellow	Y. Blue
Z. Neutral	AA. Grey	BB. White
CC. Ground	DD. Green w/ Stripe	EE. Green

- FF. The color coding on No. 8 AWG and smaller conductors shall be continuous in length. No taping, painting or other means of coding will be acceptable. Conductors No. 6 AWG and larger and conductors operating above 600 volts shall be black with color coded tape visible at each point of access or view.
- GG. All circuits shall be identified at each termination and at all accessible locations such as manholes, hand holes, and pull-boxes. A circuit name shall be assigned based on the equipment at the load end of the circuit. Add a suffix letter if necessary to make the circuit number unique. Utilize sleeves for conductor sizes #2 AWG and smaller, and marker plates attached with nylon tie cords for larger conductor sizes. Taped-on markers or markers relying on adhesives shall not be allowed.

- HH. Conductors used for temporary construction power shall not be used for the permanent installation, and the permanent conductor system shall not be used for construction power unless authorized in writing by the Engineer. Circuit protective devices shall never be temporarily bypassed.
 - II. Cables shall be pulled and installed without splices. Splices shall only be made with the Engineer's approval.
 - JJ. Apply fireproofing tape to cables in hand holes and manholes, and in other locations such as vaults, throughout their exposed length. Follow the tape manufacturer's installation instructions closely.
- 3.02 TESTING
- A. Perform visual and mechanical inspection of each individual exposed power cable #6 AWG and larger for physical damage, correct terminations in accordance with the Drawings, cable bends in accordance with bending radius requirements, proper circuit identification, proper lug type, tightness of bolted connections with proper torque level per NETA ATS, Table 10.12 or manufacturer's specifications, and proper grounding.
 - B. Perform Insulation Resistance Testing of all conductors #6 AWG and larger with respect to ground and each adjacent conductor. Apply 1,000 volts dc for one minute on 600 volts insulated conductors in accordance with NETA. Minimum insulation resistance values shall not be less than 50 meg-ohms. Investigate all deviations between adjacent phases.
 - C. Perform Continuity test by ohmmeter method to ensure proper cable connections of all conductors #6 AWG and larger.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 - GENERAL

1.01 STANDARDS

- A. All electrical systems shall be grounded in accordance with the National Electrical Code, Local Codes, these Specifications and the contract drawings.

PART 2 - PRODUCTS

2.01 CABLE AND EQUIPMENT

- A. Use green colored and bare stranded copper conductors.
- B. Use approved ground clamp manufactured for such purpose.
- C. Use approved grounding electrodes and ground rod.
- D. Make permanent ground connection with exothermic weld method.

PART 3 - EXECUTION

3.01 GENERAL

- A. In general, alternating current circuits of 600 volts and below, surge suppressors, conductor raceway systems, and platform steel framework shall be effectively and permanently connected to a grounding system by means of copper conductors having cross section as required by the National Electrical Code and of capacity sufficient to ensure continuity and continued effectiveness of the ground connections under conditions of excess current. If some of the equipment to be grounded is not covered herein by detailed instructions or is not shown completely and clearly on the Drawings, such provisions of the National Electrical Code as may apply are to be considered minimum requirements for the work.
- B. All metallic conduit systems, whether used for power or lighting wiring, shall be installed in such a manner as to produce electrical continuity and shall be bound together at one or more points and connected to the building system ground, except that isolated sections of conduit not exceeding 4 feet in length are not to be grounded or bonded unless specifically called for.
- C. Rigid metal conduit systems made up with fittings, boxes, and apparatus housings having fully-threaded hubs need no additional provisions for continuity of ground. If the conduit system contains cutouts, pull boxes, junction boxes, switchboxes, etc., to which the conduit is fastened by means of locknuts and bushings, such interruptions in the grounding continuity shall be eliminated by bonding the conduit to the housings or by

separately grounding each box and conduit sections, etc., that are so isolated. Grounding wedge lugs shall be used between all bushing and metal boxes. Paint and other nonconducting material shall be removed from the surface of conduit, fittings, and metal housings prior to connecting grounding clamps, straps, or other devices.

- D. Equipment Grounding: Panel, starters, lighting fixtures, motor control center, etc., for power and lighting constitute the fundamental center of the associated distribution systems. As such, the metallic enclosures, frames, and other noncurrent carrying metal parts of this equipment shall be connected by one or more grounding conductors to the grounding system. Install a ground connection from the ground bus of switchgears, MCCs, and other electrical panels with ground bus to the ground grid.
- E. All motor frames shall be grounded. The ground conductor shall be run inside the conduit containing the power conductors. In the case of most 3-phase circuits, this means a fourth conductor in each branch circuit. The grounding conductor may be as large as the power conductor or as small as allowed by Section 250 of the NEC but shall not be smaller than No. 12 AWG. The grounding conductor shall be stranded, with green insulation through No. 4 AWG; larger sizes may be bare stranded. Ground connection at the motor shall be terminal lug or servit post inside motor conduit box and the other end connected to the ground bus in the motor control center.
- F. Transformer Grounding: Bond the neutrals of outdoor substation transformers and distribution transformers within buildings to system ground network, and any additional grounding electrodes shown near the transformers. Connect the case of the transformer to the grounding system as well.
- G. In making ground connections, the surfaces to all parts that will touch shall be thoroughly cleaned to ensure making good electrical contacts.
- H. All clamped joints shall be made up firmly. Thermal joints shall be equal to CadWeld Type TA. Where exposed to mechanical injury, the grounding conductor shall be suitably protected by pipe or other substantial guard. If guards are iron pipe or other magnetic material, the grounding conductor shall be electrically connected to both ends of the guard to reduce impedance of the circuit.
- I. Grounding conductors shall be without splice or joint if applicable and shall be straight and short except that when laid underground they shall be laid slack to prevent their being readily broken unless otherwise mechanically protected.
- J. No fuse, switch, circuit breaker, or similar disconnecting devices shall be inserted in the grounding conductor or connection throughout the entire installation.
- K. Grounding conductors shall be medium hard drawn, stranded bare copper wire sized as required by the National Electrical Code Article 250. Conductors Size No. 6 and smaller may be solid; Size No. 4 and larger shall be stranded. Ground wire shall be carried in conduit to the grounding point.
- L. Ground rods where required, shall be of copper-clad steel not less than ¾-inch in diameter, 10 feet long or as shown on the Contract Drawings, and driven full length into the earth. The maximum resistance of a single driven ground shall not exceed 5 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, a minimum of 2 additional rods shall be installed not less than 10 feet on center. Connections between grounding conductors and ground rods shall be mechanical if exposed, thermal if buried.

- M. Except where specifically indicated otherwise, all exposed noncurrent-carrying metallic parts of electrical equipment, raceway systems, and neutral conductor of the wiring system shall be grounded. The ground connection shall be made at the main service equipment and shall be extended to driven rods on the exterior of the building.
- N. All neutral conductor shall be continuous throughout the system and shall be grounded only at the point of origin of the service neutral.
- O. All receptacles shall have provision for grounding conductor connection, and shall be grounded to the grounding conductor and outlet box.
- P. All exposed steel columns, tanks, ladders, towers, and elevated platform shall be effectively grounded using No. 4/0 or larger bare copper grounding conductors and driven ground rods. Where multiple columns or tanks must be grounded, ground points shall be interconnected by minimum No. 4/0 bare copper grounding conductors buried approximately 18 inches below finished grade.
- Q. Anchor bolts securing exposed electrical equipment, structures, metal enclosures, and tanks located outdoors shall be electrically connected to the steel reinforcement in the concrete foundation or footing. Connection shall consist of minimum No. 2/0 bare copper conductors and mechanical grounding clamps.
- R. Surge arrestor ground terminals shall be connected to the equipment ground bus. Ground paths for lightning and surge arresters and capacitors shall be kept as short and direct as practical. If possible, arresters shall be connected in direct shunt relationship to the equipment terminals. Supporting brackets shall be connected directly to the equipment frame.
- S. Grounding resistors, where specified, shall have a resistance within the boundary limits specified in IEEE Standard 142 in order to minimize transient overvoltages during ground faults. Ground fault current shall not be less than that required to operate protective devices or 25 amps, whichever is greater.
- T. Lightning and surge arresters used with grounded-wye systems which do not have effectively grounded neutrals as defined by IEEE Standard 100 shall have a voltage rating not less than the maximum phase-to-phase voltage of the system.
- U. The grounding system equivalent resistance shall not exceed 5 ohms for the entire system under normally dry conditions unless otherwise specified. After the grounding system has been installed and all connections made, tests shall be made by the Electrical Contractor to determine the resistance to earth. If the resistance of the entire system exceeds the specified maximum, additional ground rods shall be driven to reduce the resistance to this value.
- V. Gas piping or piping conveying flammable liquids shall not be used as grounding electrodes.
- W. The use of salts or electrolytes to reduce earth resistance shall not be permitted.
- X. Permanently connect the green ground conductor to each receptacle junction box (self-tapping screw).
- Y. Install a ground rod inside each manhole. Connect any metallic raceway and all noncurrent-carrying metal parts to the ground rod with a No. 6 AWG (min.) copper

conductor. Similarly, provide a ground rod for every pole-mounted site lighting and make grounding connections.

Z. Bond the standby generator neutral to the grounding system with a properly sized grounding conductor. Ground the generator frame to the ground grid.

AA. Ground metallic fences when used to enclose electrical equipment.

BB. Bond all metallic pipe systems, ducts, etc as per the NEC.

3.02 TESTING

A. Ground resistance testing shall be done in accordance with IEEE standard 81-1993 to confirm that the resistance of the grounding system is 5 ohms or less (test shall not be run within 72 hours of last rain fall). Ground resistance testing shall be done with the power off and the grounding electrode conductor isolated from the utility, and the service to prevent coupling. The testing equipment shall use the fall of potential method of earth resistance measurement. The test equipment must be designed to reject the effects of stray ac and dc currents on readings.

B. A test report shall be submitted to the engineer and included in the O & M manual for the project. The report shall include but not be limited to:

1. Date of test
2. Time of day
3. Weather condition (ex. 82°F, 82% RH, cloudy)
4. Date of last rain fall $\geq \frac{1}{2}$ " in a 24 hour period
5. Soil type
6. Minimum of five (5) readings
7. A plot of all readings indicating a level spot in the curve at the system resistance.

C. All ground resistance testing shall be done in the presence of the Engineer. If test measurements indicate a grounding system resistance of greater than 5 ohms, additional grounding cable shall be buried in locations and at the direction of the Engineer. Ground resistance testing as described herein shall be repeated after the additional ground cable has been installed. The installation of grounding cable and repeat testing shall be done until the 5 ohm grounding system resistance has been achieved.

D. Test equipment for ground resistance measurement shall be Vibroground by Associated Research, Megger null balance by Biddle, or alternate approved by the Engineer.

END OF SECTION

SECTION 26 05 33

BOXES

PART 1 - GENERAL

1.01 SCOPE

- A. All boxes required throughout the electrical raceway system shall be furnished and installed in accordance with the requirements which follow.

1.02 SECTION INCLUDES

- A. Outlet boxes.
- B. Pull and junction boxes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Boxes shall be equal to Appleton, Crouse Hinds, Raco, or Steel City.

2.02 MATERIALS

A. Outlet Boxes

1. Sheet Metal Outlet Boxes: NEMA OS-1, UL 514; galvanized steel, with ½ inch male fixture studs where required.
2. Cast Boxes: Cast ferrous alloy with galvanized or cadmium finish, deep type, gasketed cover, threaded hubs for use with steel conduit, UL 514.
3. Floor Boxes: Full adjustable, steel, water and concrete tight equal to T&B model number 68 D.
4. Except as indicated otherwise on the drawings or in these specifications, all junction boxes or pull boxes 4 inch trade size or smaller in any dimension shall be galvanized malleable iron or acceptable equal cast ferrous metal for use with steel conduit.

B. Pull and Junction Boxes

1. Junction boxes and pull boxes shall be as indicated on the drawings and as specified in these specifications. Where no type or size is indicated elsewhere for junction boxes or pull boxes, they shall be in accordance with the requirements of the NEC, Article 314, Paragraphs 28, 29, 40 and 41 for use on systems with a nominal rating of 600 volts and less, and Section IV for use on systems with a nominal rating of over 600 volts.

- a. Sheet Metal Boxes: NEMA OS-1; galvanized steel. Boxes larger than 12-inches in any dimension are hinged enclosure. Equal to Hoffman Bulletin A-51.
 - b. Cast Metal Boxes: NEMA 250; Type 4, galvanized cast iron box and cover, neoprene gasket, stainless steel cover screws, UL listed as raintight. Provide flat-flanged type for surface mounting and outside flange recessed cover type for underground use. Boxes for sidewalk or other traffic areas to have appropriate duty cover with non-skid finish.
 - c. Corrosion Resistant Boxes: UL 508 Type 4X, gasketed screw cover. For boxes larger than 12-inches in any dimension provide hinge on one side and stainless steel toggle latches (equal to Hoffman A-FC412SS) on the other three sides. Equal to Type 304 stainless steel equal to Hoffman Bulletin A-51.
 - d. Floor Boxes: Floor boxes shall be cast iron with bolted covers. The boxes shall be approximately 12 inches square and 10 inches deep, and shall be located as shown on the drawings with the lid flush with the finished floor. Floor boxes shall be Neenah No. R-7517-DB or alternate acceptable to the Engineer.
2. Electrical enclosures, except junction boxes and pull boxes 4 inch trade size and smaller and other enclosures of cast metal, shall be constructed from steel plate reinforced as required to provide true surfaces and adequate support for devices mounted thereon.
 3. Except as indicated otherwise in these specifications or on the drawings, all junction boxes and pull boxes larger than 4 inch trade size for use in indoor locations shall be sheet steel hot-dip galvanized after fabrication and those for use in outdoor or wet corrosive indoor locations shall be 316 stainless steel.

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordination of Box Locations

1. Provide boxes as shown on Drawings, and as required for splices, taps, wire pulling and equipment connections.
2. Box locations shown on the Drawings are approximate unless dimensioned. Verify box locations prior to rough-in. Coordinate mounting heights and locations of outlet mounted above counters, benches, backsplashes, and other furnishings. Any outlet may be relocated by up to 10 feet before it is permanently installed without incurring additional cost.

PART 4 - INSTALLATION

A. Box Installation

1. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.
2. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
3. Support boxes independently of conduits openings.
4. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
5. In inaccessible ceiling areas, position outlets and junction boxes within 6-inches of recessed luminaires to be accessible through luminaire ceiling opening.
6. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
7. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Align adjacent devices at different elevations in one vertical line. Set floor boxes level and flush with finish flooring material.
8. Unless otherwise noted, use only cast outlet boxes. Galvanized steel boxes shall be used only in finished areas where they are completely concealed within walls or ceiling.
9. Conduit openings in boxes shall be made with a hole saw or shall be punched. Field locate holes in junction and pull boxes so as to afford the maximum bending radius for the conductors.
10. Boxes mounted on concrete shall be secured by self-drilling anchors. Mounting on steel shall be by drilled and tapped screw holes, or by special support channels welded to the steel, or by both. Boxes larger than 4 inch trade size shall be leveled and fastened to the mounting surface with not less than 1/4 inch air space between the enclosure and mounting surface. All mounting holes in the enclosure shall be used.
11. Except as prevented by the location of other work, all junction boxes and outlet boxes shall be centered on structures.
12. Label cover of junction boxes with circuit numbers of conductors in the box.
13. Medium voltage boxes and low voltage boxes shall be kept separate. Provide physical partitions where required.
14. Unless indicated otherwise on the drawings or in these specifications, electrical enclosures except junction boxes and pull boxes 4 inch trade size and smaller, shall be as follows:

<u>Location</u>	<u>Enclosure Type</u>
Indoor (Nonhazardous)	
Dry Areas	NEMA 1
Areas where moisture conditions are more severe than those for which NEMA 1 enclosures are intended	NEMA 4
Wet, corrosive indoor areas	NEMA 4X SS
Outdoor (Nonhazardous)	NEMA 4X SS
Class 1, Division 2	NEMA 7

END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 - GENERAL

1.01 SCOPE

- A. Work covered by this section includes furnishing all labor, equipment, and materials required to install electrical conduit and fittings as specified herein and/or shown on the Drawings.
- B. The Contractor's attention is called to the fact that all conduits and conduit fittings are not necessarily shown completely on the Drawings, as the Drawings are schematic. However, the Contractor shall furnish and install all conduits and conduit fittings indicated or required for the proper connection and operation of the equipment.

1.02 SHOP DRAWINGS AND ENGINEERING DATA

- A. Shop drawings and engineering data shall be submitted in accordance with requirements of the Section 01 33 00 of these Specifications.

1.03 STORAGE AND PROTECTION

- A. Store and protect conduit and fittings in accordance with the manufacturer's recommendations and requirements of the Section 01 60 00 of these Specifications. Conduit shall be stored aboveground and adequately supported.

1.04 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with requirements of the Section 00 72 14 Article 23 of these Specifications.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Unless otherwise shown or specified, all conduits shall be rigid metal. See the paragraph on Conduit Application for additional information.
- B. Conduit terminations at electrical equipment such as electric motors, dry type transformers and heaters shall be made using liquid-tight, flexible metal conduit.
- C. Damaged, dented, flattened, or kinked conduit shall not be used.
- D. All conduit shall be installed and braced to meet the local and state code requirements for seismic bracing.

2.02 RIGID METAL CONDUIT

- A. Rigid metal conduit shall be heavy wall, mild steel conduit conforming to ANSI C80.1 and Federal Specification WW-C-581, hot dip galvanized both inside and out. All conduits shall bear the approved stamp of the Underwriters Laboratories.
- B. Rigid metal conduit shall be by Allied Tube & Conduit, Republic, or equal.

2.03 RIGID NONMETALLIC CONDUIT

- A. Rigid nonmetallic conduit for voltages 600V and less shall be Schedule 40 heavy wall polyvinyl chloride (PVC) electrical conduit rated for 90 degrees C conductors and conforming to NEMA TC-2, Type EPC-40-PVC. It shall be listed by Underwriters Laboratories in conformance with the National Electrical Code. Conduit fittings, elbows, and joint cement shall be produced by the same manufacturer as the conduit. Conduits shall be as manufactured by Carlon, Allied Tube and Conduit, Borg-Warner, or equal.
- B. Rigid nonmetallic conduit for voltages higher than 600V shall be polyvinyl chloride (PVC) power duct rated for 90 degrees C conductors and conforming to NEMA TC-6, Type EB. Conduit fittings, elbows, and joint cement shall be produced by the same manufacturer as the conduit. Conduit shall be as manufactured by Carlon, Olin, or equal.

2.04 PLASTIC-COATED RIGID METAL CONDUIT

- A. Rigid metal conduit prior to application of plastic coating shall conform to Part 2.02, Rigid Metal Conduit, of this section.
- B. Plastic coating shall be polyvinyl chloride (PVC) bonded to the metal a uniform thickness of 40 mils the full length of the conduit except the threads. The bond between the metal and PVC coating shall be equal or greater than the tensile strength of the PVC coating.
- C. A coupling shall be furnished loose with each length of conduit and shall have a PVC sleeve extending 1 pipe diameter, or 2-inches, whichever is least, beyond the end of the coupling. Elbows shall have the same thickness of PVC coating as on the conduit. All threaded conduit and elbow ends shall have plastic thread protectors.
- D. The rigid steel galvanized PVC coated conduit and fittings shall be KorKap as manufactured by Plastic Applicators, Houston, Texas; Plasti-Bond as manufactured by Pittsburgh Std. Div. of Robroy Industries, Verone, Pa.; or equal.
- E. PVC-coated rigid conduit shall meet the ASTM D870 Boil Test.

2.05 RIGID ALUMINUM CONDUIT

- A. Rigid aluminum conduit shall be manufactured of 6063 alloy in temper designation T-1. The fittings shall be of the same alloy.
- B. All conduits shall bear the approved stamp of the Underwriters Laboratories and be manufactured to ANSI C80.5 and Federal Specification WW-C-540c.
- C. Rigid Aluminum conduit shall be by Republic, Allied Tube and Conduit, or equal.

2.06 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Flexible conduit shall have an oil-resistant, liquid-tight jacket in combination with flexible metal reinforcing tubing and shall be designed for use with waterproof fittings.

An integral ground wire shall be pulled. Flexible conduit shall be American Brass Sealtite Type UA as manufactured by Electric-Flex Company; Flexible Metallic Conduit as manufactured by Ideal Industries, Inc; or equal. Only Underwriter's Laboratories approved fittings shall be used.

2.07 CONDUIT FITTINGS AND BUSHINGS

- A. Wherever conduits terminate in sheet steel boxes, double bonding type locknuts and bushings shall be used except when terminating in cast hubs. All bushings shall be insulated metallic type, equal to O. Z. Electrical Manufacturing Company, Type B; T & B Company, 1200 Series; Appleton Electric Company, Type BU-I; or equal.
- B. Where conduits terminate in steel or cast NEMA 4 enclosures with no factory-installed threaded hubs, a threaded hub shall be installed equal to Myers Electric Products, Inc., Type ST or STG; Appleton Electric Company, Type HUB; Crouse-Hinds, Type HUB; or equal.
- C. All conduits terminating at motor control centers shall be suitably grounded to the motor control center ground bus using grounded type insulated bushings equal to O. Z. Electrical Manufacturing Company, BLB or IGB; Appleton, Type BIB; Thomas and Betts, 3800 Series; or equal.
- D. Conduit expansion fittings shall be O. Z. Electrical Manufacturing Company, Type EX with Bonding Jumper, Type XJ; Appleton, Type SJ with Type XJB4 Bonding Jumpers; Crouse-Hinds, Type XJ with GC100 Bonding Jumper; or equal.
- E. All outdoor conduit penetrations shall enter the enclosures, panels, junction boxes from the bottom side. Top and side penetrations are not permitted without the Engineer's approval.
- F. All outdoor conduit hubs shall be watertight Myers hubs.

2.08 CONDUIT BOXES

- A. Exposed conduit boxes and pulling elbows shall be of die-cast, copper-free aluminum with threaded body and removable neoprene- gasketed cover. Conduit boxes shall conform to Federal Specification W-C-586a and shall be Crouse-Hinds "Condulet," Appleton "Unilet Form 85," or equal.

PART 3 - EXECUTION

- A. GENERAL
- B. Minimum size conduit shall be 3/4 inch aboveground and 1 inch below ground except where noted otherwise, and no conduit shall have more than 40 percent of its internal area occupied by conductors.
- C. During construction all installed conduits shall be temporarily plugged, capped, or otherwise protected from the entrance of dust, trash, moisture, etc., and any conduits that may become clogged shall be replaced. No conductor shall be pulled in until all work that might cause damage to the conduit or conductors has been completed.

- D. Conduit connections to sheet metal enclosures shall be securely fastened by double lock nuts inside and outside and shall have grounding bushings.
- E. Conduit straps or brackets secured to concrete, brick, or masonry shall be by means of expansion bolts, toggle bolts, or approved drill anchors. No wood plugs will be permitted.
- F. Conduits supported from building walls shall be installed with at least 1/4-inch clearance from the wall using pipe spacers equal to Appleton Electric Company, T & B Company, Steel City, or equal. Clamp back to prevent the accumulation of dirt and moisture behind the conduit.
- G. Unless otherwise shown or specified, exposed rigid conduit shall be installed parallel or at right angles to structural members, surfaces, and building walls.
- H. Two or more conduits in the same general routing shall be parallel with symmetrical bends.
- I. Conduits shall be at least 12 inches from high temperature piping, ducts, and flues.
- J. Conduit installed horizontally shall allow headroom of at least 7 feet, except where it may be installed along structures, piping, equipment, or in other areas where headroom cannot be maintained because of other considerations.
- K. Wherever necessary conduit boxes and pulling elbows shall be inserted in the lines. Gaskets shall be used to ensure a dust and watertight installation on all conduit boxes and fittings.
- L. All bends and turns in conduits shall have a bend radius of not less than 6 times the internal diameter of the conduit. Bends shall be made using an approved bender to provide smooth bends with no kinks, dents, or flattening.
- M. All concealed conduit shall be placed in walls, floors, ceilings, or slabs at the proper time in accordance with the progress of the work. The Contractor shall cooperate in every respect in meeting schedules and shall not delay the structural work unnecessarily. Conduits embedded in concrete shall be blocked and braced in place by use of adequate conduit separators to prevent displacement during pouring of the concrete. Where conduit interferes with structural steel, steel reinforcement, or in the opinion of the Engineer occupies too much space in the slab, the conduits shall be rearranged or installed exposed as directed by the Engineer. No additional payment will be made for such rearrangement of conduit whether or not additional conduit or fittings might be required.
- N. Conduit wall seals with water stops shall be installed in outside walls below grade for all incoming or outgoing underground conduit emerging directly into the building area. The conduit wall seals shall have a pressure ring and sealing grommet to ensure a watertight installation.
- O. Conduit expansion fittings and ground bonding jumpers shall be installed on all conduits passing through building expansion joints to provide movement in the conduit system.
- P. Where groups of conduits terminate together or pass through floors, provide template to hold conduits in proper relation to each other and to building.

- Q. Conduits shall be plugged or capped with plastic caps during construction to protect threads and prevent entrance of dirt and water.
 - R. Conduits shall be adequately supported at intervals as required by the National Electrical Code. One to two exposed conduits running parallel to each other may be supported by strap anchors, or 1-hole clamps (walls only). Exposed conduits larger than 2 inches or groups of more than 2 conduits run parallel shall be supported by means of minimum 12 gauge, slotted steel channels fitted with 2-piece, bolted pipe clamps. All conduit supports, clamps, straps and brackets shall be stainless steel for corrosion resistance.
 - S. Runs of conduit shall not contain more than four 90-degree bends (360-degrees total) between conduit boxes panelboards, or terminations. In general and to the extent practical length of conduit runs between conduit boxes or similar means of access shall not exceed 100 feet.
 - T. Exposed service entrance conduits and main feeder conduits shall be identified using stenciled letters at intervals not to exceed 20 feet. Size of letters shall be equal to one-half the diameter of the conduit or 2 inches, whichever is less.
 - U. In Class 1, Division 2 areas, the contractor is responsible for installing seal-off fittings as required by Articles 500, 501, and 502 of the National Electric Code. The drawings do not show seal off fittings and it is the contractor's responsibility to locate and install the seal-offs based on field routing of the conduit.
 - V. Ream raceways, butt ends into couplings, 3 quarter bends per run maximum, plug raceways until wiring is pulled in place. Exposed conduits shall be run parallel and perpendicular to walls, floor, and ceiling. Multiple conduit runs shall be racked using Unistrut or Kindorf channels and pipe clamps. Install conduits in concrete slabs between the top and bottom layers of reinforcing steel. Maximum size of conduits in slabs is 1 inch. Crossing of conduits in slabs shall be avoided, if possible.
 - W. PULL WIRES: Raceways for wiring by others or for future shall contain a No. 14 galvanized steel pull wire or equivalent plastic cord with 300 lb. tensile strength.
 - X. EXPANSION JOINTS: Furnish and install expansion joints where conduit crosses building expansion joints and for straight runs exceeding 100 ft. in length.
 - Y. PULL BOXES: Maximum length between pull points shall be 200 ft. for pulls with two 90 degree bends, and 100 ft for pulls with three 90 degree bends. Furnish and install pullboxes, junction boxes, handholes, or conduit bodies where bends or pulling lengths exceed these specifications.
- 3.02 INSTALLATION OF RIGID METAL CONDUIT
- A. Terminations and connections of rigid metal conduit shall be threaded. Conduits shall be reamed free of burrs and terminated with insulated metallic conduit bushings.
 - B. Conduit threads shall be coated with a petroleum base corrosion-inhibitor with low electrical contact resistance before assembly equal to Burndy Engineering Company, Inc., Penetrax "A" or equal screw thread lubricant (zinc-petroleum or zinc-chromate compounds are permissible).

- C. All conduits shall be suitably grounded to the plant ground grid using grounded type insulated bushings, O. Z. Electrical Manufacturing Company, Type BLG or IGB, T & B Company, Appleton Electric Company, or equal.
 - D. Conduit across structural joints where structural movement is allowed shall have bonded, weathertight expansion and deflection fitting the same size as the conduit.
 - E. Support spacing for conduits 1 inch and smaller shall not exceed 6 feet, and conduits 1¼ inches and larger shall not exceed 10 feet. Supports shall be as specified under basic electrical materials and methods. Conduits 1½-inch and smaller may be supported by 1-hole conduit straps and 2 inches and larger shall be supported by 2-hole conduit straps. Conduit racks shall be as manufactured by Unistrut, Kindorf, or equal. Conduit racks shall be 316 stainless steel.
 - F. Conduit joints shall be made up tight using a pipe wrench. Channel lock pliers will not be permitted, and unions shall be used as necessary to aid in the installation. Conduits shall be cut square and the ends reamed smooth after threading to prevent injury to conductors. Conduit joints in concrete or exposed to weather or damp locations shall be drawn up tight and coated with insulating paint before casting in concrete or painting exposed conduit system.
 - G. Plastic-coated rigid metal conduit and fittings shall be installed in accordance with the manufacturer's specifications and recommendations. Any damage to the plastic coating shall be repaired in accordance with the manufacturer's requirements. The manufacturer shall certify the installers before installation can be started.
- 3.03 INSTALLATION OF RIGID NONMETALLIC CONDUIT
- A. Field bending of polyvinyl chloride conduit shall be made with appropriate equipment. No torches or flame-type devices shall be used.
 - B. When joints are to be made with polyvinyl chloride conduit, the conduit shall be cut with a fine-tooth saw and deburred. Conduit ends shall be wiped clean of dust, dirt, and shavings and shall be dry. Solvent cement shall be applied to bond the joint. The joint should be watertight.
 - C. Polyvinyl chloride conduit shall be installed in accordance with the manufacturers' specifications and recommendations.

3.04 INSTALLATION OF LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Terminations at motors shall be made with flexible liquid-tight metal conduit from conduit stub to terminal box; flexible connection shall be made as short as possible. Flexible conduit shall be Type UA, black. Underwriter's Laboratories approved flexible liquid-tight conduit connectors shall be as manufactured by Thomas and Betts Company, Appleton Electric Company, or equal.
- B. Uncoated flexible metal conduit may be used for short connections between junction boxes and lighting fixtures or speakers installed in suspending ceiling systems. Flexible metal conduit shall be connected using Underwriters Laboratories approved grounding connectors.

- C. Recessed fluorescent and incandescent fixtures located in accessible ceilings may be connected to an outlet box above the ceiling thru flexible conduit “whips”. Run a separate ground wire in all conduit, including flexible fixture whips. DO NOT loop flexible conduit from one fixture to another. Metal-clad cable fixture whips shall be permitted for light fixture whips provided they do not exceed 6-feet in length and are provided by the light fixture manufacturer. Final connections to motors, motor driven equipment, transformers, and vibrating equipment shall be made thru sealtite flexible metal conduit, 36" maximum length.

3.05 INSTALLATION OF UNDERGROUND CONDUIT

- A. All underground conduits shall be concrete-encased unless otherwise noted on the Drawings or directed by the Engineer. No conduit shall be concealed or encased until the Engineer has inspected the conduit for proper installation and accurate placement.
- B. The Contractor shall be responsible for all excavating, draining trenches, forming of duct assembly and protective concrete envelope, backfilling, and removal of excess earth.
- C. Underground conduit shall be installed with a minimum 3-inch per 100-foot downward slope for drainage. Drains shall be provided at all low points.
- D. Bends and turns shall be made using long sweeps. Ninety-degree bends will be used only where required and shall be kept at a minimum. Field coordinate conduit bends with minimum bending radius of conductor prior to installation of conduits.
- E. Where rigid nonmetallic conduits emerge from underground, an adapter from rigid nonmetallic conduit to rigid metal conduit shall be installed and all exposed conduit shall be rigid metal conduit. The last bend shall be rigid galvanized steel.
- F. All rigid metal conduit risers shall be protected with 2 coats of a Bitumastic compound before concrete is poured from a point 12 inches below grade to a point not less than 6 inches above grade or surface of concrete. All stub-ups shall extend upward with one length of rigid metal conduit until after concrete is poured to assure vertical alignment.
- G. Conduits shall be encased in concrete with 3-inch minimum concrete cover all around.
- H. Concrete for concrete encasement shall be Class B concrete conforming to requirements of the section entitled “Cast-In-Place Concrete,” of these Specifications. Longitudinal and lateral steel reinforcement shall be provided as shown on the Drawings.
- I. All underground conduit runs for voltages less than 600 volts shall be at least 24 inches below grade and shall have a minimum conduit separation of 4 inches. Provide a magnetic warning tape 12” below finished grade.
- J. All underground conduit runs for voltages over 600 volts shall be at least 36 inches below grade and shall have a minimum conduit separation of 4 inches. Conduit shall have a minimum 4-inch concrete cover on all sides. Provide a magnetic warning tape 12” below finished grade.
- K. All underground conduit runs shall be rodded and a mandrel drawn through followed by a swab to clean out any obstructions that may cause cable abrasions. The mandrel shall be 12 inches in length and the diameter ½ inch less than the inside diameter of the conduit.

- L. All underground conduit runs shall be marked by a strip of permanently colored red polyethylene tape, 0.004 inch thick and 6 inches wide, buried above the conduit and 6 inches below finished grade. Provide a magnetic warning tape 12" below finished grade.
 - M. All spare conduits shall be provided with permanent waterproof caps at stub-ups and shall be furnished with a 500# fiber tape pulling wire. Waterproof raceway tags shall be attached to the pulling cords, at each end and at each intermediate pulling point. The raceway tags shall identify the origin and destination of the conduit.
- 3.06 CONDUIT APPLICATION
- A. Install the following conduit types, unless otherwise shown on the drawings.
 - 1. Outdoors, Exposed (Not Buried): Aluminum Rigid Conduit
 - 2. Indoors
 - a. Dry Areas Galvanized Rigid Steel Conduit
 - b. Wet Areas Galvanized Rigid Steel Conduit
 - 3. Underground (Under Slabs-on-Grade, Encased or Embedded in Concrete)
 - a. PVC Schedule 40
 - 4. Hazardous Gas Areas
 - a. Aluminum Rigid Conduit
 - 5. Chemical Feed Areas
 - a. PVC Schedule 40
 - 6. Transition Areas and Final Connections to Equipment
 - a. Motor Connections – Flexible metal, liquid-tight conduit.
 - b. Light Fixture Connections – Flexible metal non-metallic liquid-tight conduit in dry areas and liquid-tight in wet areas.
 - 7. Fire Alarm Conduit: Conduit used for Fire Alarm System wiring shall be red, similar to Allied Fire Alarm EMT.

END OF SECTION

SECTION 26 18 38

VARIABLE FREQUENCY DRIVE (VFD)

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test and place in satisfactory operating condition all variable frequency drives (VFDs) as specified herein and indicated on the Drawings.
- B. The variable frequency drives shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- C. Three VFDs shall be provided for the new High Service Pumps. The VFD shall be rated for:
 - 1. 200HP, 480V, 3Ph, 1780 RPM, Variable Torque
 - 2. 300HP, 480V, 3Ph, 1780 RPM, Variable Torque.
 - 3. 450HP, 480V, 3Ph, 1780 RPM, Variable Torque
- D. Each VFD shall be furnished with a passive filter to reduce harmonics to IEEE 517 requirements.

1.02 CODES AND STANDARDS

- A. VFDs shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. NEMA 250 – Enclosure for Electrical Equipment
 - 2. IEEE 519 – Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
 - 3. NEMA ICS 7 – Adjustable-Speed Drives
 - 4. NEMA ICS 61800-2 – Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems
 - 5. UL 508A – Standard for Industrial Control Panels
 - 6. UL 508C – Standard for Power Conversion Equipment

1.03 DEFINITIONS

- A. The following definitions are provided for clarity with regard to the language used in this Specification:
 - 1. Variable Frequency Drive (VFD) – The complete custom-engineered VFD as packaged within an overall enclosure, including the VFD unit and all other components within that enclosure as specified herein.

1. VFD Unit – The solid-state power electronic device or devices within the VFD.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 1. Shop Drawings
 2. Operation and Maintenance Manuals
 3. Spare Parts List
 4. Reports of Certified Shop and Field Tests
 5. Manufacturer's Field Start-up Report
 6. Manufacturer's Representative's Installation Certification
 7. Pre- Equipment-Selection Harmonic Study Report

1.05 SHOP DRAWINGS

- A. A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. C. Shop drawings for each VFD shall include but not be limited to:
 1. 1. A Compliance, Deviations, and Exceptions (CD&E) letter. If the shopdrawings are submitted without this CD&E letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.
 2. Complete bill of material and catalog data sheets for all equipment and devices comprising the VFD.
 3. Product data sheets for all system components, including but not limited to:
 - a. VFD units
 - b. Harmonic correction devices and/or equipment, e.g. line reactors
 - c. Output reactors and/or output filters
 - d. Pilot lights and pilot devices

- e. Control and timing relays
 - f. Enclosure fans
 - g. Contactors
 - h. Power supplies
 - i. Control power transformers
 - j. Current transformers
 - k. Potential transformers
 - l. Circuit breakers and/or motor circuit protectors
 - m. Fuses
 - n. Terminal blocks (power, control, and shorting)
 - o. Surge protective devices
4. Layout drawings of the VFD that include:
- a. All cabinet or enclosure dimensions, access details, and weights.
 - b. Required clearances around the enclosure, e.g. ventilation.
 - c. Conduit entry areas and/or stub-up locations.
 - d. Nameplate sizes, colors, and locations.
 - e. Physical arrangement of door mounted devices located on the variable frequency drive enclosure.
 - f. Physical arrangement of all interior components, including DIN-rail- mounted devices.
 - g. General "catalog data sheet" layout drawings which are not specific to the systems specified herein are not acceptable.
5. Custom schematic and interconnection wiring diagrams of all electrical work, including but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, terminal blocks and identification numbers, wire numbers, and other equipment comprising the complete system.
- a. These drawings shall be circuit specific for each motor-load combination (e.g. Influent Pumps, Odor Fans, etc.). Specific equipment names consistent with the Drawings shall appear on each respective diagram.
 - b. Indicate all devices, regardless of their physical location, on the schematic diagrams.
 - c. Electrical ratings of all equipment and devices shall be clearly indicated on the schematic diagrams.
 - d. Standard schematics and wiring diagrams that are not custom created by the manufacturer for the variable frequency drives for this project are not acceptable.

- 1) Confirmation of spare parts requirements as specified herein.
- 2) The shop drawing information shall be completed and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

1.06 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals and Section 11000, Equipment - General Provisions.
- B. Prior to completion and final acceptance of the project, the Contractor shall furnish and install "as-built" wiring diagrams for each VFD. These final drawings be included in the O&M manuals and an additional copy that is plastic laminated and securely placed inside each VFD.
- C. The O&M manual shall include the "as-commissioned" parameters of each VFD in both print and digital formats.
- D. If the VFDs require computer software or configuration, the O&M manual shall include copies of all programming guides/manuals.

1.07 SPARE PARTS

- A. The VFDs and accessories shall be furnished with all spare parts as recommended by the equipment manufacturer. In addition to the manufacturer recommended spare parts, the Contractor shall furnish the following spare parts:
 1. Two (2) sets of fuses for each size and type of fuse provided.
 2. One (1) HMI per type of HMI provided.
 3. One (1) set of enclosure air filters for each VFD.
 4. For each VFD unit with field-replaceable internals, furnish one (1) fully functional main control circuit board per VFD unit size provided.

1.08 WARRANTY

- A. Contractor shall warrant that the material and workmanship of all components and the operation of the VFDs and auxiliary equipment is in accordance with the latest design practices and meets the requirements of this Specification.
- B. Warranty shall include, but not be limited to the following:
 1. Replace components found to be faulty and make changes in equipment arrangement or make adjustments necessary to meet the equipment or functional requirements or this Specification.
 2. System rewiring and component substitution/rebuild.
 3. All accessories and appurtenances provided by the VFD manufacturer.

- C. Warranty shall be in effect for a period of 48 months following final acceptance of each VFD.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be equipment of proven performance. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.
- B. The Contractor shall obtain the VFDs from one manufacturer who shall also manufacture and assemble the enclosure and major equipment components including, but not limited to the VFD unit and bypass starters. The manufacturer shall have five years minimum of experience in the manufacture of similar units and shall have a general distribution to the electrical trade. Subcontracting of wiring and/or third-party assembly is not acceptable.
- C. The VFDs shall be manufactured by Eaton PowerXL EGS (DG1) VFD, the Square D Company equal, or Allen-Bradley (Rockwell Automation) equal or approved equal. VFDs shall not exceed the dimensions as shown on the drawings.
- D. The VFD manufacturer shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for obtaining all load, torque, speed and performance requirements from the appropriate sources and integrating these into a VFD that fulfills the requirements of this Specification.

2.02 VFD SYSTEMS

- A. Operating Conditions
1. The following operating conditions are applicable for all equipment of this Specification.
 - a. Humidity: 0-95%.
 - b. Ambient Temperature: 0 degrees Celsius to plus 40 degrees Celsius.
 - c. Altitude: up to 3,300 feet
- B. Basic Design and Performance
1. Each VFD shall be a complete alternating current electric drive system including all hardware and software necessary to accomplish variable speed operation of a motor and load combination. VFDs shall be provided in accordance with the requirements indicated on the Drawings and as described in these Specifications.
 2. Each VFD shall be suitable for operation as part of a 480 VAC, 3-phase, 60 Hertz power distribution system. The complete VFD system shall have a minimum short circuit current rating of 85,000 amperes symmetrical at rated voltage for the influent pump VFDs, and 65,000 amperes symmetrical at the rated voltage for all other VFDs, unless otherwise indicated on the Drawings.
 3. Each VFD shall be suitable to operate, at times, on a limited power source engine- generator set. The VFD shall be provided with equipment and devices to prevent waveform distortion as specified herein.

4. Each VFD shall be provided with control and sequence logic as specified herein and indicated on the Drawings. Control and sequence logic shall be designed such that the motor-load combination can be operated in the manual mode upon control and sequence logic failure, including all necessary personnel and equipment safety interlocks. Each VFD shall be designed such that specific control and protection functions can be attained through simple programming by either factory engineers or Owner's trained operating personnel.
5. Motor control circuits shall be wired in accordance with the requirements specified herein and/or indicated on the Drawings.

C. Components

1. Each VFD shall contain the number of VFD units as shown on the Drawings and required for the applications.
2. Each VFD shall contain and/or be furnished with the harmonic correction equipment as shown on the Drawings and required for the applications.
3. Each VFD shall contain the number of auxiliary contacts, control power transformer(s), pilot devices and indicating lights, control relays, elapsed time meters, and other devices as specified herein, shown on the Drawings and required for the applications.
4. Power terminal blocks for VFD output to the motor shall be fixed-mounted to a backplane or the enclosure. Mounting the terminal blocks on DIN rails is not acceptable.
5. Electrical bus, including ground bus, shall be tin-plated copper. Power and control wiring shall be copper, color coded and identified in accordance with these Specifications.
6. Each VFD shall be of modular construction allowing normal maintenance and repair to be done with ordinary hand tools. Design and install power electronic component assemblies so that, where practicable, components can be individually removed and replaced.
7. Auxiliaries, including fans, that are required for rated load operation at maximum ambient temperature, shall be 100% redundant. New and unused spare replacement fan(s) or air conditioning unit(s), shipped in original carton, may be provided in lieu of 100% redundant auxiliaries if accepted in writing by the Engineer.
8. Circuit boards and electrical components shall meet the corrosion protection requirements specified in these Specifications. Varnished or epoxy encapsulated circuit boards and tropicalized contactors suitable for corrosive environments shall be furnished.
9. Motor Circuit Protectors
 - a. Each VFD shall be protected by a motor circuit protector (MCP).
 - b. Motor circuit protectors shall be completely enclosed molded case devices with a current sensing coil in each of the 3 poles and have a magnetic trip adjustment located on the front. The motor circuit protector shall be manually operable. The protector shall be designed to meet the NEC requirement concerning motor full load and locked-rotor current. Ampere ratings shall be clearly visible. Contacts shall be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes, consisting of metal grids mounted in an insulating support.

- c. The motor circuit protector shall be operated by a toggle type handle and shall have a quick make, quick break overcenter switching mechanism that is mechanically trip free from the handle, so that the contacts cannot be held closed against short circuits and abnormal currents. Tripping shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. All latch surfaces shall be ground and polished. All poles shall be so constructed that they open, close, and trip simultaneously.
- d. Each pole of these motor circuit protectors shall provide instantaneous short circuit protection by means of an adjustable magnetic only element.
- e. Motor circuit protector ratings, modifications, etc., shall be as specified herein and as required for the VFD and motor load combination. MCP ratings shall be determined by the VFD manufacturer.

D. Controls

- 1. Each VFD shall be provided with automatic and manual controls as shown on the Drawings and as required to comply with all Specifications. Controls and indicators to accomplish operation and maintenance shall be located on the variable frequency drive equipment assembly as specified herein and indicated on the Drawings.
- 2. The Elementary Control Schematics shown on the Drawings are representative of design intent only. The manufacturer shall be responsible for providing all additional components, controls, and internal wiring necessary to meet the design intent.
- 3. VFD circuitry shall be designed such that the enclosure cooling fans only run when the VFD unit is producing output power. Designs that allow the enclosure cooling fans to run continuously when the VFD unit is energized but not producing output power are not acceptable. Fans that are used exclusively to provide cooling for the VFD unit (and not the overall enclosure) are permitted to run continuously if required by the VFD manufacturer's design standards/practices.

E. Enclosures

- 1. Equipment within the VFD enclosure shall be NEMA 1 and shall be arranged so that it does not interfere with the entry of conduits and cables into the enclosure.
- 2. NEMA 1 and NEMA 12 VFD enclosures shall be force ventilated with front accessibility and the following:
 - a. Enclosures shall be provided with washable enclosure air intake filters that can be replaced while the enclosure door remains closed.
 - b.
 - c. Enclosures shall be designed for bottom or top entry of conduits and cables as required.
 - d. Enclosures shall be finished in ANSI-61 gray enamel or in a color to match the complete line-up of equipment as indicated on the Drawings and accepted by the Engineer.
- 3. Each VFD shall be designed such that rear access to the enclosure is not required for operations, maintenance, or repair tasks.

4. The VFD manufacturer shall reference the Drawings for maximum dimensions of the VFDs. The Engineer shall be notified prior to the initial shop drawing submittal if exceptions to the dimensions indicated on the Drawings are necessary.
5. Integrating VFDs into a motor control center assembly is not permitted unless specifically shown as integrated on the Drawings.
6. Enclosure doors shall have full length piano type hinges and shall be braced to prevent sag when fully open.
7. Each VFD enclosure shall be supplied with an industrial, heavy-duty flange-mount handle mechanism for the operation of the VFDs disconnecting means as follows:
 - a. The mechanism shall be engaged with the disconnect device at all times as an integral part of the unit regardless of the unit door position.
 - b. The operator handle shall have an up-down motion with the down position as off. The ON-OFF condition of the disconnecting means shall be permanently marked on the handle operator.
 - c. It shall be possible to lock the handle in the "OFF" position with up to three
 - d. (3) 3/8-inch diameter shackle padlocks and in the "ON" position with one
 - e. (1) 3/8-inch diameter shackle padlock.
 - f. The operator handle shall be mechanically interlocked such that the disconnecting means cannot be closed with the enclosure door open, nor
 - g. can the enclosure door be opened when the disconnecting means is closed. A defeater mechanism shall be provided so that qualified personnel can bypass these interlocks for maintenance and testing purposes. The defeater mechanism shall allow the enclosure door to be opened without interrupting the operation of the VFD.

F. Nameplates and Legend Plates

1. Provide engraved plastic nameplates and legend plates to identify each VFD and associated door mounted devices and internal components.
2. Equipment names and/or numbers and device identification text shown on the Drawings shall be used as the basis to engrave the nameplates and legend plates. Where the equipment identification text would exceed the capacity of the VFD manufacturer's standard nameplate/legend plate size, the manufacturer shall provide larger nameplates and/or additional nameplates as necessary. Abbreviating equipment names/numbers and device identification text is not acceptable.
3. Control components mounted as part of the assembly, such as fuse blocks, control relays, pushbuttons, switches, and similar devices, shall be suitably marked with identification corresponding to appropriate designations on the manufacturer's wiring diagrams.

G. Keypads

1. Each VFD shall include a door-mounted drive LCD keypad for operator interface

2.03 VFD UNITS

- A. The VFD unit shall be the Eaton PowerXL EGS (DG1) VFD, or equal by Square D or Allen-Bradley or approved equal from other manufacturers.
- B. Basic Design and Performance
1. Each VFD unit shall be of adjustable frequency, adjustable voltage, pulse width modulated (PWM) design. The units shall be microprocessor controlled, fully digitally programmable, and capable of precise and repeatable speed regulation of three phase 480 VAC NEMA Design A or B induction motors. Units for other than NEMA Design A or B induction motors (e.g. NEMA Design C) shall be coordinated with the requirements of that respective load.
 2. Each VFD unit shall consist of a semiconductor rectifier system, direct current link, and pulse width modulated inverter. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the motor at the desired speed.
 3. Each VFD unit shall operate the motor and produce full rated nameplate horsepower at the motor output shaft without exceeding motor nameplate full load current and with the motor not exceeding rated total temperature not including the additional temperature increment that constitutes the motor service factor. Motor shall retain its service factor when operated by the variable frequency drive.
 4. The overall efficiency of each VFD unit shall be a minimum of 95% when operating the specified motor-load combination at rated voltage, frequency, and current.
 5. Each VFD unit shall provide smooth, stepless changes in motor speed and acceleration over the entire operating speed range from minimum to maximum speed. The VFD unit shall be provided with adjustable maximum and minimum frequency limits.
 6. Each VFD unit shall maintain a desired output frequency (setpoint) with a steady state accuracy of 0.5% of rated frequency of 60 Hertz for a 24 hour period and a repeatability of 0.1% of rated frequency of 60 Hertz.
 7. Each VFD unit shall be capable of operating the specified load continuously at any speed within the operating speed range of 10% to 100% of rated speed. The minimum and maximum continuous operating speeds shall each be adjustable within this speed range. The variable frequency drive shall provide for field adjustment of these setpoints.
 8. Each VFD unit shall be capable of controlled linear acceleration and deceleration. Each VFD unit shall be capable of ramping the speed of the motor-load combination from the minimum selected operating speed to the maximum selected operating speed in a minimum of 30 seconds. Each VFD unit shall have two (2) field-adjustable speed setpoints for the variable frequency drive to skip equipment resonant frequencies. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.
 9. Voltage or current unbalance between phases of the VFD unit output voltage shall not exceed 3% of the instantaneous values. The VFD unit shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 3%. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.

10. Each VFD unit shall operate continuously without interruption of service or damage to equipment during transient input voltage variations of plus or minus 10% for a duration of 15 cycles. Unacceptable voltage fluctuations on the supply bus shall cause under or overvoltage protection to trip and remove supply voltage from the drive system. VFD unit output voltage regulation shall be plus or minus 2%.

C. Features and Characteristics

1. Each VFD unit shall be furnished with a Human Machine Interface (HMI) to provide controls and indication to accomplish maintenance and operational functions as specified herein and shown on the Drawings. The HMI shall be password protected after startup to prevent unauthorized personnel from making changes. The HMI shall at minimum provide indication of the following:
 - a. Input Voltage
 - b. Output Voltage
 - c. Output Current
 - d. Output Frequency
 - e. Output Speed from 0-100%
 - f. Alarm Read-out
 - g. Bearing Temperature
 - h. Motor RTD Temperature
2. Each VFD unit shall provide a 4-20 mADC output signal that is proportional to the drive output frequency for use as speed feedback and remote speed indication.
3. Each VFD unit shall accept a 4-20 mADC input command signal to control the output frequency in the automatic and/or manual control modes as specified herein or indicated on the Drawings. The system shall accept the input increase/decrease command with a resolution that permits incremental changes in speed equal to or less than 0.1% of rated speed.
 - a. Where shown on the Drawings, VFD units shall also accept the input from speed potentiometer(s) for manual speed control. Each VFD unit shall be capable of automatically switching between the input command signals as shown on the Drawings.
4. Each VFD shall be able to communicate to the Control Panel Ethernet/IP for control and monitoring (in lieu of hardwiring). All data, including, but not limited to, RTD values shall be made available.
5. When operating in the automatic mode, the VFD unit shall shut down during a power outage or sustained undervoltage event. A sustained undervoltage event is defined as voltage that is less 75% of nominal, for more than 0.5 seconds. Upon restoration of normal power and after an adjustable time delay (0-2 minutes; motor has coasted to zero speed and there is no backspin), the VFD unit shall automatically restart and then ramp up to speed as required by the control system. Personnel shall not be required to reset the system manually after a shutdown caused by a power outage or sustained undervoltage event.
6. Each VFD unit shall have a multiple attempt restart feature.

7. Each VFD unit shall have an automatic current limit feature to control motor currents during startup and provide a "soft start" torque profile for the motor-load combination. The VFD unit shall also limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short circuit. The current limit protection setting shall be field adjustable.
8. Each VFD unit shall be furnished with programmable electronic overload and torque limits.
9. Each VFD unit shall have an automatic trip feature which will remove the drive output from the motor and allow it to decelerate safely. This automatic system shall lock-out the VFD unit and indicate the fault only upon the following conditions:
 - a. Output voltage unbalance (trip threshold field set).
 - b. Open phase.
 - c. Motor overload.
 - d. Motor stator winding fault (phase-to-ground, phase-to-phase).
 - e. Unacceptable voltage variation.
 - f. High variable frequency drive equipment temperature.
 - g. VFD failure as determined by the manufacturer.
 - h. Component failure.
 - i. Overcurrent.
10. Provide each VFD unit with transmitted and received radio interference protection. In addition, provide protection against starting a rotating motor, both directions (coasting to zero speed and backspin). In the event that a motor automatic restart feature (catch the motor "on-the-fly") is provided in the VFD unit as standard, this feature shall be capable of being disabled.
11. Each VFD unit shall include on-line diagnostics, with an automatic self-check feature that will detect a variable frequency drive failure which in turn affects motor operation and generates an alarm contact output rated for 125 VDC suitable for interfacing with the control system.
 - a. Diagnostics shall operate a visual alarm indicator that is visible on the variable frequency drive equipment cabinets without opening the cabinet doors.
 - b. Diagnostics shall provide an easily readable output that can be used to isolate a failure.
 - c. Provide an event and diagnostic recorder to printout in narrative English of the specific fault(s) and the sequence in which the faults occurred. An indication of the "First Out" failure is a minimum for fault sequence detection.
 - d. Provide a normally open dry contact for each alarm function to enable remote indication.

12. Each VFD unit shall communicate the following parameters to the Pump Control Panel via Ethernet/IP protocol. Provide any necessary hardware gateways to provide this communication capability. The following parameters, at a minimum, shall be communicated:
 - a. Monitoring and Control
 - b. Current (all phases)
 - c. Voltage (all phases)
 - d. KW, KVAR, KVA
 - e. Power Factor
 - f. Bearing Temperature
 - g. Motor RTD Temperatures
 - h. HOA Status
13. Each VFD shall include the capability to monitor motor winding RTDs (6 / 2 per phase) and an upper and lower bearing RTD. The RTD will be a PT100. The value shall be displayed on the LCD and alarms / fault setpoints shall be adjustable from the LCD.
14. Each VFD unit shall be provided with input/output (I/O) expansion cards as necessary to facilitate connection of all I/O specified herein and shown on the Drawings.

2.04 2.04 HARMONIC CORRECTION

- A. Harmonic correction devices for each VFD shall be as specified herein and located as shown on the Drawings.
- B. Input Line Reactors
 1. 6-pulse VFD units shall be provided with input line reactor and/or integral DC link reactor. Total reactor impedance shall be a minimum of 3% and shall not exceed 5%.
- C. Passive Filters
 1. VFD units shall be provided with a passive harmonic filter in addition to the integral DC link reactor specified above (if present.)
 2. Passive harmonic filters shall be sized to attenuate harmonics resulting from operation of the VFD-driven motor load to no more than 5% THID when operating at full load, and no more than 8% THID when operating at 30% of full load. The filter shall be equipped with power contactors configured to remove the capacitors from the circuit when the VFD-driven loads are not in operation. The harmonic filters shall be as manufactured by TCI, MTE Corporation, Mirus International, or engineer approved equal.
 3. Passive filters shall be integrated into the VFD unless accepted in writing by the Engineer or shown as separately mounted from the VFD on the Drawings.

PART 3 - PART 3 – EXECUTION

3.01 INSTALLATION

- A. The VFDs shall be installed as shown on the Drawings and in accordance with the manufacturer's installation instructions.
- B. Install VFDs to allow complete door swing required for component removal.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
 - a. None required.
 - 2. Certified Shop Tests and Reports
 - a. Submit description of proposed testing methods, procedures, and apparatus.
 - b. Factory test the complete VFD in accordance with IEEE and NEMA standards.
 - c. Submit factory bench-test data to indicate that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.
 - 3. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA acceptance requirements.
 - b. The Contractor shall field measure actual harmonic distortion with tests performed by an independent testing agency acceptable to the Owner after satisfactory full-load operation. The Contractor shall provide the harmonic distortion reports with the O&M Manual.
 - 1) Unless otherwise indicated on the Drawings, the harmonic distortion measurements shall be made at each load center where VFDs are present.
 - 2) Harmonic distortion measurements shall be made after VFD installation. One set of measurements shall be made with the VFD loads inactive, and one set of measurements shall be made with the VFD loads running at design capacity.
 - c. Vibration Analysis to determine Frequency Skipping – During start-up, the VFD manufacturer shall provide a vibration analysis on each motor to determine the VFD skipping frequencies. The manufacturer shall program the drive such that the critical speeds (resonance frequency) are blocked in the inverter control which should be done through the skip frequency function. Frequencies shall be determined in the field with the Owner and Engineer present at the time of the vibration analysis. Vibration analysis shall be done by MDI (Mr. Andy Dortch 229-942-5087), MST (Mr. Richard Talley 770-489-6078), or local testing agency with 5 years of experience on similar applications.
- B. Acceptance of a shop test does not relieve Contractor from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the contractor of responsibilities. Certification on materials and

records of shop tests necessary for the inspector to verify that the requirements of the Specifications are met, shall be made available to the inspector Submit signed and dated certification that all of the factory inspection and testing procedures described herein have been successfully performed by the Contractor prior to shipment.

3.01 VFD SETTINGS-SOFTWARE

- A. Once testing and startup has been successfully completed, the Owner shall receive 2 USB drives with all VFD settings. File names shall match the VFD/Pump that it pertains to. The Owner shall also be provided with a copy of the programming software to connect to the VFD's and to download VFD settings in the event settings are lost or the VFD has to be replaced in the future.

3.02 SERVICES OF A MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall provide the services of a qualified manufacturer's factory-trained technical representative who shall adequately supervise the installation and startup of all equipment furnished under this Contract. The manufacturer's representative shall certify in writing that the equipment has been installed in accordance with the manufacturer's recommendations. No further testing or equipment startup may take place until this certification is accepted by the Owner.
- B. The manufacturer's technical representative shall perform all startup and field acceptance testing as specified herein.
- C. The Contractor shall provide training for the Owner's personnel. Training shall be conducted by the manufacturer's factory-trained representative who shall instruct Owner's personnel in operation and maintenance of all equipment provided under this Section. Training shall be provided for two (2) sessions of four (4) hours each. Training shall not take place until after the VFDs have been installed and tested. Training shall be conducted at times coordinated with the Owner.
- D. The services of the manufacturer's representative shall be provided for a period of not less than as follows:
 - 1. One (1) trip of two (2) working days during installation of the VFDs.
 - 2. One (1) trip of two (2) working days to perform startup and field acceptance testing of the VFDs.
 - 3. One (1) trip of one (1) working day to perform training as specified herein.
 - 4. One (1) trip of one (1) working day two (2) months before the expiration of the warranty to identify any issues to be corrected under warranty.
- E. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor.

- END OF SECTION -

SECTION 26 24 00

SWITCHBOARD (GROUP MOUNTED FEEDERS)

PART 1 - GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the contract drawings.
- B. Switchboard shall be rated NEMA 3R and be furnished in a stainless-steel enclosure.

1.02 REFERENCES

- A. The low voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:
 - 1. NEMA PB-2
 - 2. UL Standard 891

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Master drawing index
 - 2. Front view elevation
 - 3. Floor plan
 - 4. Top view
 - 5. Single line
 - 6. Schematic diagram
 - 7. Nameplate schedule
 - 8. Component list
 - 9. Conduit entry/exit locations
 - 10. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - 11. Major component ratings including:

- a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
- 12. Cable terminal sizes
- 13. Product data sheets
- B. Where applicable, the following additional information shall be submitted to the Engineer:
 - 1. Busway connection
 - 2. Connection details between close-coupled assemblies
 - 3. Composite floor plan of close-coupled assemblies
- 1.04 SUBMITTALS – FOR CONSTRUCTION
 - A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
 - 2. Wiring diagrams
 - 3. Certified production test reports
 - 4. Installation information
 - 5. Seismic certification and equipment anchorage details as specified
- 1.05 QUALIFICATIONS
 - A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
 - B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
 - C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- 1.06 REGULATORY REQUIREMENTS
 - A. The low-voltage switchboard shall be UL listed and labeled.
- 1.07 DELIVERY, STORAGE AND HANDLING
 - A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- 1.01 Operation and Maintenance Manuals

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.08 PRODUCTS

1.09 MANUFACTURERS

- A. Eaton / Cutler-Hammer
- B. Square D
- C. GE / ABB

1.10 RATINGS

- A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current as shown on the drawings.
- B. Voltage rating to be as indicated on the drawings.

1.11 CONSTRUCTION

- A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- B. All sections of the switchboard shall be front and rear aligned with depth as shown on the drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall. The switchboard shall be constructed in a dead-front type assembly.
- C. The assembly shall be provided with adequate lifting means.
- D. The switchboard shall be equal to Cutler-Hammer type Pow-R-Line C utilizing the components herein specified and as shown on the drawings.
- E. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.
- F. The vertical sections shall run the entire length of the switchboard.

1.12 BUS

- A. All bus bars shall be tin-plated aluminum. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
- B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
- C. A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

- D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

1.13 WIRING/TERMINATIONS

- A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.
- C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.
- D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

1.14 MAIN LUGS

- A. The main lugs shall be rated for five (5) runs of 600 kcmil, copper conductors.
- B. Main feeder will enter the enclosure from the bottom.

1.15 METERING

- A. Provide a power meter equal to Eaton Power Xpert 2000. Meter shall include an Ethernet / IP connection for remote monitoring.

1.16 FEEDER PROTECTIVE DEVICES

A. MOLDED CASE PROTECTIVE DEVICES

1. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be equal to Cutler-Hammer.
2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
3. Feeders shall be able to exist the switchboard from the top, side, and/or bottom.
4. See drawings for numbers for feeder protective devices.

1.17 SURGE PROTECTION DEVICE

- A. Provide an integral surge protection device with integral breaker such that device can be removed and replaced without having to de-energize the switchboard.
- B. Surge Protection Device shall be rated 250ka per phase / 125ka per mode.
- C. 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 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.
- D. 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.
- E. Electrical Noise Filter – Each 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.
- F. 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.
- G. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
 - 1. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - 2. 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.
 - 3. 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.
 - 4. 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.
 - 5. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
 - 6. Remote Status Monitor – 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.

7. Audible Alarm and Silence Button – 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.
 8. Surge Counter – 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.
 9. 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.
- H. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
- I. Overcurrent Protection
- J. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element 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.
- 1.18 ENCLOSURES
- A. NEMA 3R stainless steel enclosure
- 1.19 NAMEPLATES
- A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.
- B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- 1.20 FINISH

- A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

PART 2 - EXECUTION

2.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground
- B. The manufacturer shall provide three (3) certified copies of factory test reports.

2.02 MANUFACTURER'S CERTIFICATION

- A. A certified test report of all standard production tests shall be available to the Engineer upon request.

2.03 TRAINING

- A. The Contractor shall provide a training session for up to five (5) owner's representatives for 1 normal workdays at a job site location determined by the owner.
- B. A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

2.04 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.
- B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the concrete slab. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

2.05 FIELD ADJUSTMENTS

- A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

- B. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

2.06 SPARE PARTS

- A. Provide 3 spares for all expendable items for each rating such as fuses and pilot lamps.
- B. All spares shall be clearly and permanently labeled on the outside of the packaging as to the manufacturer's name and equipment model number.

2.07 3.07 MARKING, SHIPPING AND REJECTION

- A. Marking and Shipping
 - 1. Each separate component of the equipment shall be identified.
 - 2. Each housing enclosure for equipment such as circuit breakers shall be provided with a permanently attached nameplate. The nameplate shall indicate the tagging or nomenclature shown in the equipment list, and shall be permanently mounted on the face of the enclosure where it will be clearly visible.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 SCOPE

- A. Panelboards shall be furnished in the quantities and with components, devices, and materials meeting the requirements indicated in the panelboard list on the drawings.
- B. Panelboards shall be designed and fabricated in accordance with NEMA standards for panelboards. Each panelboard, or all current controlling devices in each panelboard, shall be UL labeled and listed.
- C. Panelboards shall be NEMA 4X SS (stainless steel) where shown on the panelboard schedule.

1.02 SECTION INCLUDES

- A. Panelboards.

1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00.

1.04 REFERENCE STANDARDS

- A. Design, manufacturing and assembly of elements of panelboards and devices herein specified shall be in accordance with the standards of the below listed organizations.
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical Manufacturers Association (NEMA)
 - 3. National Fire Protection Association (NFPA)
 - 4. National Electrical Code, NFPA-70 (NEC)
 - 5. Underwriters Laboratories, Inc. (UL)

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Equipment shall be manufactured by General Electric, Siemens, Square D, or Eaton/Cutler- Hammer.

2.02 MATERIALS

- A. Panelboards: NEMA PB-1; UL 67.
- B. Rating: Voltage and ampere ratings are shown on the Drawings. Unless otherwise indicated, interrupting ratings (RMS symmetrical) are 14,000 amps for 480 volt panelboards and 10,000 amps for 240 and 208 volt panelboards.
- C. Cabinets: Indoor panelboards shall be in NEMA 1 cabinets. The cabinet shall be code gage gasketed steel. It shall consist of a box with a removable front complete with hinged door, latch and master keying lock. The box shall be flanged galvanized sheet steel. Boxes shall be a minimum of 20 inches wide and 5-7/8 inches deep. Code gauge galvanized steel; sized to accommodate devices indicated and afford wire bending space in accordance with NEC requirements.
- D. Outdoor panelboards shall be in a NEMA 4X cabinet.
- E. Fronts: Surface or flush as indicated, door-in-door construction, finished in light grey enamel over a rust inhibitor. Furnish flush lock for fronts less than 48-inches high and vault type handle with three point catch for fronts 48-inches and higher. Key all locks alike.
 - F. Bus:
 - 1. Rigid buses of copper or copper alloy shall be installed to provide consecutive phasing of branch circuit connections.
 - 2. The solid neutral bus shall have solderless connectors, numbered to agree with branch circuits. The bus shall be insulated from the cabinet with provisions for grounding.
 - 3. The equipment grounding bus with main lug shall have solderless connectors, numbered to agree with branch circuits.
- G. Circuit Breakers:
 - 1. NEMA AB-1; molded case type, thermal-magnetic trip with internal common trip on multi-pole breakers.
 - 2. Protective overcurrent devices for branch circuits shall be of the size and type indicated on the drawings.
 - 3. Panelboard branch circuit breakers shall be the thermal magnetic, bolt-in, individually front replaceable type and shall indicate "On", "Off", and "Tripped". Circuit breakers indicated as multiple pole shall be common trip.
 - 4. Continuous and interrupting ratings shall be as shown on the drawings. Provide breaker fully rated for interrupting ratings noted; series ratings are not acceptable.
- H. Provide engraved nameplates giving the voltage rating and panel designation as indicated. Provide a UL service entrance label for panelboards used as service entrance equipment.
- I. Surge Protection: Where indicated, provide transient voltage surge suppressors.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All panelboards shall be installed so that circuit breakers are not more than 6 feet above the finished floor and not lower than 24-inches above the floor. Panels shall be installed in accordance with the requirements of NEC Article 312 Paragraph 8, Article 408 and the following articles.
- B. The cabinets shall be leveled and securely fastened to the mounting surface, utilizing all of the mounting holes provided in the panelboard cabinets.
- C. Each cabinet shall be installed, conduits connected, and wires pulled before the panel interior is installed. A heavy cardboard panel front shall be temporarily secured to the front of the panelboard to protect the interior from dirt or damage until the permanent metal front is installed.
- D. Each panelboard front shall be carefully aligned and adjusted until its edges are parallel to the panelboard interior and the building lines, and then shall be firmly secured with the fasteners provided.
- E. For flush mounted panels provide a 3/4-inch empty raceway for each three unused spaces and spare poles. Terminate in a junction box located above the ceiling or other approved accessible location for future extension.
- F. Prior to energizing panelboards clean out construction dirt and debris. Paint any scratches on the trims or dead front barriers. Megger each phase to phase and ground to insure that no short circuits exist.
- G. Adjust panel barriers so that no openings occur between them and panel front. Provide filler plates and plugs as necessary to maintain dead front integrity.
- H. A circuit directory cardholder and card with a clear plastic covering shall be provided on the inside of each cabinet door. The directory card shall provide a space to identify each circuit in the panelboard. The directory for each panelboard shall be accurately typed with the names of the load served by each breaker to permit ready location of the protective devices controlling circuit loads. Note spare circuits in pencil.
- I. Each panelboard shall be identified with a suitable engraved nameplate mounted at the top of the front plate. Each nameplate shall be engraved with the panelboard identification indicated on the Contract Drawings.

END OF SECTION

SECTION SECTION 26 28 16

MOTOR DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Three phase motor disconnect switches.
- B. Single phase motor disconnect switches under 1 horsepower.
- C. Single phase motor disconnect switches over 1 horsepower.

1.02 1.2 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.01 THREE PHASE MOTORS

- A. Disconnect switches for three phase motors shall be a heavy duty type rated 600 volts, and shall be UL listed. Outdoor switches shall be in NEMA 3R enclosures; indoor switches in non-corrosive atmospheres shall be in NEMA 1 enclosures; indoor switches in wet, corrosive atmospheres shall be in NEMA 4X enclosures.
- B. Switches shall be single throw non-fusible with provisions for padlocking the handle in the open position.
- C. Switches shall have an auxiliary set of contacts for switch position indication. Interlock with VFDs when present.

2.02 SINGLE PHASE MOTORS UNDER 1 HORSEPOWER

- A. Disconnect devices for single phase motors up to 1 horsepower, not controlled with magnetic starters, shall be toggle operated manual motor starters rated 240 volts ac. Outdoor switches shall be in NEMA 3R enclosures; indoor switches in non-corrosive atmospheres shall be in NEMA 1 enclosures; indoor switches in wet, corrosive atmospheres shall be in NEMA 4 enclosures.
- B. Switches shall be non-fusible type with a thermal overload trip assembly. The handle shall include a handle guard with provisions for padlocking the handle in the open position. Continuous ratings shall be as shown on the Contract Drawings.

2.3 SINGLE PHASE MOTORS OVER 1 HORSEPOWER

- A. Disconnect switches for single phase motors over 1 horsepower in non-corrosive atmospheres and having separate overload protection and control shall be general duty

rated for 240 volts ac. Outdoor switches shall be in NEMA 3R enclosures and indoor switches shall be in NEMA 1 enclosures.

- B. Disconnect switches for single phase motors over 1 horsepower in corrosive atmospheres and having separate overload protection and control shall be heavy duty rated for 600 volts ac in NEMA 4X enclosures.
- C. Switches shall be 2 pole non-fusible, single throw type with provisions for padlocking in the open position. Continuous ratings shall be as shown on the Contract Drawings.

2.03 NAMEPLATES

- A. Nameplates shall be provided for each motor disconnect switch to identify the load served and "Served From: " data to indicate voltage, phase, and which MCC or Panelboard/Circuit # disconnect is fed from. Nameplates shall be engraved with 3/16 inch minimum height black letters on a white background, and shall be mounted on the front of the enclosure with stainless steel screws.

2.04 ACCEPTABLE MANUFACTURERS

- A. Disconnect switches shall be manufactured by General Electric, Cutler Hammer, Square D, or Engineer approved alternate.

PART 3 - PART 3 INSTALLATION

3.01 INSTALLATION

- A. Install in accordance with the manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

A. TESTS

1. Megger each bus, phase-to-phase and phase-to-ground.

END OF SECTION

SECTION 26 32 13

GENERATOR AND ATS

PART 1 - GENERAL

1.01 REFERENCES

- A. The equipment covered by these specifications shall be designed, tested, rated, assembled and installed in strict accordance with all applicable standards of ANSI, NEC, ISO, U.L., IEEE and NEMA.

1.02 WORK INCLUDED

- A. The work includes supplying a complete integrated emergency generator system. The system consists of a diesel generator set with related component accessories and connecting to a new automatic transfer switch.
- B. Provide a full tank of diesel fuel after the completion of all testing.
- C. A complete system load test shall be performed after all equipment is installed.
- D. The equipment supplied and installed shall meet the requirements of the NEC and all applicable local codes and regulations. All equipment shall be of new and current production by a Manufacturer who has 25 years of experience building this type of equipment. Manufacturer shall be ISO9001 certified.
- E. Generator shall be furnished with a 480V, 3P panel (70A MB), step down transformer, and 208/120V load center. Load center shall include a main breaker and all branch breakers required. All ancillary devices (lights, block heaters, battery charger, louvers, etc.) shall be factory wired back to the load center. All conduit in enclosures shall be RGS.
- F. Provide a 1,600A, 480V, 3P Automatic Transfer Switch with Programmed Transition in a NEMA 1 free-standing enclosure.

1.03 MANUFACTURERS

- A. There shall be one source responsibility for warranty, parts and service through a local representative with factory trained service personnel.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following: (Listed in Alphabetical Order)
 - 1. Generator Set:
 - a. Caterpillar
 - b. Kohler
 - c. Onan-Cummins

1.04 SUBMITTALS

A. Engine-generator submittals shall include the following information

1. Factory published specification sheet indicating standard and optional accessories, ratings, etc.
2. Manufacturer's catalog cut sheets of all auxiliary components such as Automatic Transfer Switches, battery charger, control panel, enclosure, main circuit breaker, etc.
3. Dimensional elevation and layout drawings of the generator set, enclosure and transfer switchgear and related accessories.
4. Weights of all equipment.
5. Concrete pad recommendation, layout and stub-up locations of electrical and fuel systems.
6. Interconnect wiring diagram of complete emergency system, including generator, switchgear, day tank, remote pumps, battery charger, jacket water heater, remote alarm indications.
7. Engine mechanical data including heat rejection, exhaust gas flows, combustion air and ventilation air flows, noise data, fuel consumption, etc.
8. Generator electrical data including temperature and insulation data, cooling requirements, excitation ratings, voltage regulation, voltage regulator, efficiencies, waveform distortion and telephone influence factor.
9. Generator resistances, reactances, and time constants.
10. Generator motor starting capability.
11. Control panel schematics.
12. Oil sampling analysis, laboratory location, and information.
13. Manufacturer's and dealer's written warranty.

1.05 WARRANTY

- A. The manufacturer's standard warranty shall in no event be for a period of less than two (2) years from date completion and shall include repair parts, labor, reasonable travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair. Warranty service calls shall not include a deductible cost. Submittals received without written warranties as specified will be rejected in their entirety.

1.06 PARTS AND SERVICE QUALIFICATIONS

- A. The engine-generator supplier shall have service facilities within 75 miles of the project site and maintain 24-hour parts and service capability. The distributor shall stock parts as needed to support the generator set package for this specific project.
- B. The dealer shall maintain qualified, factory trained service personnel that can be reached within 10 minutes of an emergency call and can respond on site within 4 hours of notification, 24 hours per day.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. The generator set shall be Standby and have an 00 kW/ 1000kVA rating. The ratings shall be at 1800 RPM, 0.8 power factor, 480Y/277 VAC, 3 phase, 4 wire, 60 hertz, including radiator fan and all parasitic loads.
- B. All materials and parts comprising the unit shall be new and unused.

2.02 DIESEL ENGINE

- A. The engine shall be as manufactured by one of the approved manufacturers listed above. The engine shall be water-cooled inline or vee-type, four cycle compression ignition diesel. The engine shall be equipped with fuel, lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter, gear-driven water pump.
- B. The engine shall include a Closed Crankcase Ventilation (CCV) system. If the engine does not have integral CCV, an external system, by Racor or equal, shall be added. System shall filter crankcase fumes, returning the filtered air to the engine intake and the captured oil back to the oil pan.
- C. The complete engine block shall be machined from one casting. Designs incorporating multiple blocks bolted together are not acceptable.
- D. The engine shall utilize a gear-type, positive displacement, full pressure lubricating oil pump and water-cooled lube oil cooler. Pistons shall be spray-cooled. Provide oil filters, oil pressure gauge, dipstick and oil drain.
- E. Fuel filter and serviceable fuel system components shall be located to prevent fuel from spilling onto generator set batteries.
- F. The engine shall be equipped with an isochronous electronic governor +/- 0.25% steady state frequency variation. The governor shall be equipped with speed adjustment.

2.03 GENERATION

- A. The synchronous generator shall be a single bearing, self-ventilated, drip-proof design in accordance with NEMA MG 1 and directly connected to the engine flywheel housing with a flex coupling.
- B. The insulation material shall meet NEMA standards for Class H insulation and be vacuum impregnated with epoxy varnish to be fungus resistant. Temperature rise of the rotor and stator shall not exceed NEMA class F (130° C rise by resistance over 40° C ambient). The excitation system shall be of brushless construction.
- C. The brushless exciter shall be independent of main stator windings (either permanent magnet or auxiliary windings) and shall consist of a three-phase armature and a three-phase full wave bridge rectifier mounted on the rotor shaft. Surge suppressors shall be included to protect the diodes from voltage spikes. Generator shall have the ability to sustain short circuit current of 300% of rated current to allow protective devices to operate.
- D. The automatic voltage regulator (AVR) shall maintain generator output voltage within +/- 0.5% for any constant load between no load and full load. The regulator shall be a totally solid state design

which includes electronic voltage buildup, volts per Hertz regulation, three phase sensing, over-excitation protection, loss of sensing protection, temperature compensation, shall limit voltage overshoot on startup, and shall be environmentally sealed.

2.04 CIRCUIT BREAKER

- A. Provide a 1600A, 480V, 100% Rated, 65 kAIC generator mounted circuit breaker with L/S/I protective features, molded case or insulated case construction. Breaker(s) shall be 100% rated, UL Listed and sized as shown on the drawing(s). Breaker shall include a 12 or 24 VDC shunt trip, and shall have auxiliary position contacts wired to the genset control panel for local and remote annunciation of the circuit breaker position. The breaker shall be connected to engine/generator safety shutdowns. Breaker shall be housed in NEMA 1P22, enclosure(s) mounted on the side of the generator. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing(s), shall be supplied on the load side of breaker. Breaker shall include long term, short term, and instantaneous trip settings. All breakers rated 1000 Amps and above shall include ground fault indication.

2.05 CONTROLS

A. Generator Mounted Control Panel:

- 1. Provide a generator mounted control panel for complete control and monitoring of the engine and generator set functions. Panel shall include automatic start/stop operation, adjustable cycle cranking, digital LCD AC metering (0.5% true rms accuracy) with phase selector switch, digital engine monitoring, shutdown sensors and alarms with horn and reset, adjustable cooldown timer and emergency stop push-button. Panel shall incorporate self-diagnostics capabilities and fault logging. Critical components shall be environmentally sealed to protect against failure from moisture and dirt. Components shall be housed in a NEMA 1/IP22 enclosure with hinged lid.
- 2. Provide the following digital readouts on the Generator Mounted Control Panel:
 - a. Engine oil pressure
 - b. Coolant temperature
 - c. Engine RPM
 - d. System DC Volts
 - e. Engine running hours
 - f. Generator AC volts
 - g. Generator AC amps
 - h. Generator frequency
- 3. Control Panel Annunciation - Provide the following indications for protection and diagnostics according to NFPA 110 level 1:
 - a. Low oil pressure
 - b. High water temperature

- c. Low coolant level
- d. Overspeed
- e. Overcrank
- f. Emergency stop depressed
- g. Approaching high coolant temperature
- h. Approaching low oil pressure
- i. Low coolant temperature
- j. Low voltage in battery
- k. Control switch not in auto. position
- l. Low fuel main tank
- m. Battery charger ac failure
- n. High battery voltage
- o. Generator supplying load
- p. Spare

2.06 COOLING SYSTEM

- A. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 122° F ambient air entering the room or enclosure (If an enclosure is specified) without derating the unit and 50/50 anti-freeze mixture. The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

2.07 FUEL SYSTEM

- A. Filter/Separator - In addition to the standard fuel filters provided by the engine manufacturer, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.
- B. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping will be permitted.
- C. Flexible fuel lines shall be rated for 300 degrees F and 100 PSI.

2.08 EXHAUST SYSTEM

- A. A critical type silencer, companion flanges, and flexible stainless steel exhaust fitting properly sized shall be furnished and installed according to the manufacturer's recommendation.
- B. The silencer shall be located inside the generator set enclosure. The silencer shall be mounted so that its weight is not supported by the engine.

- C. Exhaust pipe size shall be sufficient to ensure that exhaust back pressure does not exceed the maximum limitations specified by the engine manufacturer.

2.09 STARTING SYSTEM

- A. A DC electric starting system with positive engagement shall be furnished. The motor voltage shall be as recommended by the engine manufacturer.
- B. Jacket Water Heater: A unit mounted thermal circulation type water heater. The heater watt rating shall be sized by the manufacturer to maintain jacket water temperature at 90 degrees F in an ambient temperature down to -20 Deg F. Heaters $\leq 6000\text{W}$ shall be 208 – 240V single phase, 60 Hz. Heaters greater than 6000W shall be 208 – 240V, three phase, 60 Hz.
- C. Batteries: A lead-acid storage battery set of the heavy duty diesel starting type shall be provided. Battery voltage shall be compatible with the starting system. The battery set shall be rated no less than 140 ampere hours and 1300 CCA. Necessary cables and clamps shall be provided.
- D. A battery tray shall be provided for the batteries and shall conform to NEC 480-7(b). It shall be treated to be resistant to deterioration by battery electrolyte. Further, construction shall be such that any spillage or boil-over battery electrolyte shall be contained within the tray to prevent a direct path to ground.
- E. Battery Charger: A current limiting battery charger shall be furnished to automatically recharge batteries. Charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell. It shall include overload protection, silicon diode full wave rectifiers, voltage surge suppressor, DC ammeter, DC voltmeter, and fused AC input. AC input voltage shall be 120 volts, single phase. Charger shall have LED annunciation for low DC volts, rectifier failure, loss of AC power, high DC volts. Amperage output shall be no less than ten (10) amperes. Charger shall be wall mounting type in NEMA 1 enclosure, installed in the generator set enclosure.

2.10 GENERATOR SET ENCLOSURE – SOUND ATTENUATED AND WEATHER PROTECTIVE

- A. The complete diesel engine generator set, including generator control panel, engine starting batteries and fuel oil tank, shall be enclosed in a factory assembled, weather protective enclosure mounted on the fuel tank base.
- B. The enclosure shall be constructed of corrosion resistant steel with electrostatically applied powder coated baked polyester paint. It shall consist of a roof, side walls, and end walls. Fasteners shall be either zinc plated or stainless steel.
- C. The enclosure shall reduce the ambient noise level at full load to a maximum of 75 dB at 23 feet.
- D. Number of doors on enclosure shall be as required so that all normal maintenance operations, such as lube oil change, filter change, belt adjustment and replacements, hose replacements, access to the control panels, etc., may be accomplished without disassembly of any enclosure components. Access doors shall be fabricated of the same material as the enclosure walls and shall be reinforced for rigidity.
- E. Provide six LED wall packs on exterior of enclosure to illuminate the access platform. Wall packs shall be controlled by an H-O-A switch located on interior of enclosure. In ‘A’ position, lights shall be controlled by a photocell mounted to exterior of enclosure.

- F. Handles shall be key lockable, all doors keyed alike, and hinges shall be zinc die cast or stainless steel. Fasteners shall be zinc plated or stainless steel. Doors shall be of a lift off design allowing one person to remove door if necessary.
- G. Air handling will be sized and designed by the manufacturer for 0.5" static pressure drop through enclosure.
- H. Air intake openings shall include fixed louvers with motorized dampers (120VAC power to close, fail open) and shall be screened to prevent the entrance of rodents.
- I. Radiator air exhaust shall include fixed louvers with gravity type dampers, and sound attenuated exhaust plenum with vertical discharge.
- J. Lube oil and coolant drains shall be extended to the exterior of the enclosure and terminated with drain valves. Radiator access shall be through a hinged, lockable cover on enclosure. Cooling fan and charging alternator shall be fully guarded to prevent injury.
- K. Lifting points shall be provided on base frame suitable for lifting combined weight of base tank, generator set and enclosure.
- L. A dual wall fuel tank base of 24 hour capacity at 100% load shall be provided as an integral part of the enclosure. It shall be contained in a rupture basin with 110% capacity. The tank shall be pressure tested for leaks prior to shipment and have all necessary venting per UL142 standards. A locking fill cap, a mechanical reading fuel level gauge, low fuel level alarm contact, and fuel tank rupture alarm contact shall be provided.
- M. The genset vendor shall supply a service access platform. The platform shall be of aluminum construction, shall be a minimum of 48" wide, shall provide room for full enclosure door opening, and shall include stairs and handrails per OSHA requirements. Platforms will be required on all sides / ends of the enclosure with door openings. Platform height shall be such that the control panel, breaker handle(s), and oil level dipstick shall all be within 6' from the top of the platform after installation. Installing contractor shall coordinate any additional concrete requirements to support the platform with generator supplier.

2.11 AUTOMATIC TRANSFER SWITCH

A. General:

- 1. The transfer switch shall be a 800A, NEMA 1, 480/277V, 4W, 3 Pole Automatic, 65kAIC Transfer Switch with programmed transition..
- 2. The transfer switch shall be rated for the voltage and ampacity as shown on the plans and shall have 600 volt insulation on all parts in accordance with NEMA standards.
- 3. The current rating shall be a continuous rating when the switch is installed in an unventilated enclosure, and shall conform to NEMA temperature rise standards. Designs which require cabinet ventilation are unacceptable and do not meet this specification.
- 4. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.

5. As a precondition for approval, all transfer switches complete with accessories shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems.
6. The withstand current capacity of the main contacts shall not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data.
7. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
8. Transfer switches shall comply with the applicable standards of UL, CSA, ANSI, NFPA, IEEE, NEMA and IEC.
9. The transfer switches shall be supplied with a solid state control panel as detailed further in these specifications.

10. Sequence of Operation

- a. The ATS shall incorporate adjustable three phase under-voltage sensing of the normal source.
- b. When the voltage of any phase of the normal source is reduced to 80% of nominal voltage, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.
- c. The ATS shall incorporate adjustable single phase under-voltage sensing of the emergency source.
- d. When the emergency source has reached a voltage value within 10% of nominal voltage and achieved frequency within 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.
- e. When the normal source has been restored to not less than 90% of rated voltage on all phases, the load shall be re-transferred to the normal source after a time delay of 0 to 30 minutes (programmable). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
- f. If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.
- g. The transfer switch shall be equipped with a solid state control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability.
- h. The control panel shall include indicators for timing functions, and ATS test switch.
- i. The control panel shall be provided with calibrated pots (accessible only by first opening the lockable cabinet door) to set time delays, voltage and frequency sensors. The ATS shall be capable of being adjusted while the controls are energized and the unit in

automatic mode. Designs which force a “programming mode” or require the controls be de-energized during adjustment are unacceptable.

- j. The control panel shall be opto-isolated from its inputs to reduce susceptibility to electrical noise and provided with the following inherent control functions and capabilities:
 - a) An LED display for continuous monitoring of the ATS functions.
 - b) Test switch to simulate a normal source failure.
 - c) Time delay to override momentary normal source failure prior to engine start. Field programmable 0-10 seconds (continuously adjustable via a calibrated potentiometer factory set at 3 seconds).
 - d) Time delay on retransfer to normal source, continuously adjustable 0-30 minutes, factory set at 30 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.
 - e) Time delay on transfer to emergency, continuously adjustable 0-15 seconds, factory set at 1 second.
 - f) An in-phase monitor or time delayed neutral shall be provided to prevent excessive transient currents from switching motor loads.
 - g) An interval-type automatic clock exerciser with load/no load selectability shall be incorporated in the ATS.

B. Construction and Performance

- 1. The automatic transfer switch shall be of double throw construction operated by a reliable electrical mechanism momentarily energized. There shall be a direct mechanical coupling to facilitate transfer in 6 cycles or less.
- 2. The transfer switch shall incorporate a timed, center-off (neutral) position to allow for motor and inductive load decay. Transfer time shall be adjustable from 0 to 10 minutes on transfer to either source. A mechanical interlock shall be provided to positively ensure that both sets of power transfer contacts cannot be closed simultaneously (precluding the possibility of inadvertently paralleling the ATS input sources).
- 3. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.
- 4. The contact structure shall consist of a main current carrying contact, which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.

5. The transfer switch manufacturer shall submit test data for each size switch required for this project, showing that it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings shall be as follows:

a. Any Molded Case Breaker*:

1) Size (Amps)	(RMS Symmetrical)
2) Up to 200	10,000
3) 201 - 260	35,000
4) 261 - 400	35,000
5) 401 - 1200	50,000
6) 1201 - 4000	100,000

b. Specific Coordinated Breaker*:

1) Size (Amps)	(RMS Symmetrical)
2) Up to 150	30,000
3) 151 - 260	42,000
4) 261 - 400	50,000
5) 401 - 800	65,000
6) 801 - 1200	85,000
7) 1201 - 4000	100,000

c. Current Limiting Fuse*:

1) Size (Amps)	(RMS Symmetrical)
2) Up to 4000	200,000

*All values 480 volt, RMS symmetrical, less than 20% power factor.

Note: Actual necessary current withstand ratings for this project may be higher than the minimums listed above. Refer to electrical plans for exact requirements.

6. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
7. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.

8. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.
9. A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.
10. The switch shall be mounted in a NEMA 1 indoor enclosure unless otherwise indicated on the plans.
11. Switches composed of molded case breakers, contactors or components thereof not specifically designed as an automatic transfer switch will not be acceptable.
12. To afford the advantage of a single source of supply to the owner, the automatic transfer switch shall be supplied by the manufacturer of the engine generator set and covered under the same warranty program.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment in accordance with manufacturer's recommendations, the project drawings and specifications, and all applicable codes. Installation of the system includes but is not limited to pouring a concrete pad for the generator set and automatic transfer switch, receiving and offloading the equipment, providing all labor, permits and material to install the total system.

3.02 START UP AND TESTING

- A. Coordinate all start-up and testing activities with the Engineer and Owner.
- B. After installation is complete and normal power is available, the manufacturer's local dealer shall perform the following:
 1. Verify that the equipment is installed properly.
 2. Check all auxiliary devices for proper operation, including battery charger, jacket water heater(s), generator space heater, remote annunciator, etc.
 3. Test all alarms and safety shutdown devices for proper operation and annunciation.
 4. Check all fluid levels.
 5. Start engine and check for exhaust, oil, fuel leaks, vibrations, etc.
 6. Verify proper voltage and phase rotation at the transfer switch before connecting to the load.
 7. Connect the generator to building load and verify that the generator will start and run all designated loads in the plant.
 8. Verify and test all connections to the existing automatic transfer switch.
- C. Perform a 4 hour resistive load bank test at full nameplate load using a load bank and cables supplied by the local generator dealer. Observe and record the following data at 15 minute intervals:

1. Service meter hours
2. Volts AC - All phases
3. Amps AC - All phases
4. Frequency
5. Power factor or Vars
6. Jacket water temperature
7. Oil Pressure
8. Fuel pressure
9. Ambient temperature

D. Operation and Maintenance Manuals

1. Provide three (3) sets of operation and maintenance manuals covering the generator, switchgear, and auxiliary components. Include parts manuals, final as-built wiring interconnect diagrams and recommended preventative maintenance schedules.

3.03 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 1 Section "Demonstration and Training."
1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data".
 3. Schedule training with Owner, with at least seven days' advance notice.
 4. Minimum Instruction Period: Four hours.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.01 SCOPE

- A. Work covered by this section includes furnishing all labor, equipment, and materials required to install all lighting equipment, fixtures, lamps, outlet boxes, hangers, and all related work for a complete installation.

1.02 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with requirements of the section entitled "Shop Drawings, Product Data and Samples" of these Specifications.
- B. The Contractor shall submit for review and approval, a complete list of fixtures he intends to furnish, including technical specifications, assembly details, and photometric data.

1.03 STORAGE AND PROTECTION

- A. Lighting equipment shall be stored and protected in accordance with requirements of the section entitled "General Equipment Stipulations" of these Specifications.

1.04 GUARANTEE

- A. Provide a guarantee against defective or deficient workmanship and products in accordance with requirements of the section entitled "Warranties and Bonds" of these Specifications.

PART 2 - PRODUCTS

2.01 FIXTURES

- A. Interior lighting fixtures of types and sizes as indicated on the fixture schedule shall be furnished and installed complete.
- B. All lighting fixtures, lampholders and accessories are to be Underwriters Laboratories approved.
- C. Unless called for otherwise, all pendant mounted fixtures shall be equipped with stem. Aligners shall be used on all pendant mounted fixtures hung from irregular or sloping ceilings.
- D. The fluorescent and high intensity discharge fixtures shall be complete with ETL-UL approved constant wattage ballasts and lamps as indicated on the schedule.

- E. Vapor-proof units shall have galvanized malleable iron or cast aluminum hood, glass globe and aluminum guards or as called for in the fixture schedule.
- F. All lighting fixtures which accommodate the use of gaskets shall be properly fitted with gaskets of an approved material.

2.02 LAMPS

- A. All lighting fixtures shall be provided with lamps of the proper type and wattage, as noted on the Drawings. Any lamps broken previous to the final acceptance of the work shall be replaced by the Contractor at his own expense.
- B. Incandescent lamps shall be wired with screw shell connected to neutral conductors. They shall be supplied with standard inside frosted lamps of wattage indicated, unless otherwise specified.
- C. Unless otherwise noted, fluorescent lamps shall be standard cool white.
- D. High intensity discharge lamps shall be sized as indicated on the schedule and suitable for the application indicated on the Drawings.

2.03 BALLASTS

- A. All fluorescent ballasts shall be electronic and shall bear the "CBM" and "ETL" labels. The ballasts shall be listed by Underwriters' Laboratories and shall meet all applicable ANSI lamp and ballast specifications as included in CBM requirements.
- B. The ballasts shall be sound rated and this sound group rating indicated on the ballast. The ballasts specified shall have the lowest sound rating consistent with the requirements of the application.
- C. All HID ballasts shall carry the "CBM" and "ETL" labels. The ballasts must be tested by the Underwriters' Laboratories.

2.04 CONTROLS

- A. Photoelectric control shall be provided where indicated on the Drawings.

2.05 SPARE PARTS

- A. The Contractor shall provide 2 spare lamps of each voltage and type required.
- B. Lamps shall be suitably protected against impact for long-term storage.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Contractor shall coordinate all work to assure a finished, neat appearance. Lamps, ballasts, mounting rings, fuses and other essentials shall be provided to entirely complete the lighting work in a workmanlike manner.

- B. The Contractor shall verify the final ceiling and finish schedules to insure the proper installation and mounting of fixtures; and shall coordinate with the Ceiling Contractor before making submittals.
- C. Suspended fixtures shall be supported at not more than 4-foot intervals.
- D. Pendant, chain or suspended fixtures shall be installed with a minimum clearance from bottom of fixture to floor as shown on Drawings.
- E. All fixtures shall be adequately supported in an approved manner whether or not the method or type of support is specified or detailed.
- F. The locations of lighting fixtures shall be shown in general on the Drawings. These locations shall be checked by the Engineer at the time of installation and shall be varied within reasonable limits so as to miss piping or other obstructions without extra cost to the Owner.
- G. Contractor shall specifically adhere to manufacturer's instructions and wiring diagrams where required.
- H. Install all lamps at the time fixtures are mounted. All burned-out lamps shall be replaced by the Contractor before the work is accepted by the Owner.

END OF SECTION

SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

- A. The extent of site clearing is shown on the contract drawings.
- B. Section Includes:
 - 1. Clearing and grubbing of vegetation, trees, and stumps within designated areas.
 - 2. Removal and disposal of debris, structures, and obstructions.
 - 3. Protection of existing features to remain.

1.02 RELATED DOCUMENTS

- A. Related Specifications
 - 1. Section 02 41 19 – Selective Demolition
 - 2. Section 31 20 00 – Earth Moving
 - 3. Section 31 25 00 – Erosion and Sediment Control and Storm Water Monitoring

1.03 SUBMITTALS

- A. Permits
 - 1. Contractor shall submit a copy of the Notice of Intent (NOI) and GEOS submittal receipt, as required in Section 31 25 00, a minimum of 14 days prior to commencement of construction activities.

1.04 QUALITY ASSURANCE

- A. Regulatory Compliance:
 - 1. Comply with Georgia Environmental Protection Division (EPD) and Georgia Soil and Water Conservation Commission (GSWCC) guidelines for land disturbance.
 - 2. Adhere to Georgia EPD and US Army Corp of Engineer's requirements for wetland or stream buffer protection, if applicable to the project.

1.05 PROJECT CONDITIONS

- A. Avoid clearing during heavy rain or saturated soil conditions to minimize erosion.
- B. Verify locations of utilities, protected vegetation, and property lines prior to clearing; coordinate with Owner and utility companies.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Provide clean, compacted soil per Section 31 20 00, Earth Moving, for backfilling depressions after stump removal.
- B. Provide erosion control materials in accordance with Section 31 25 00.

PART 3 - EXECUTION

3.01 GENERAL:

- A. The area shall be cleared of all existing structures, pavements, and other obstructions interfering with or in the way of construction of new work. The area shall be cleared of trees, stumps, roots, brush, rubbish and other such materials to limits at least 10 feet outside of limits of tops of cuts and toes of fill. Trees and shrubs designated to be left in place, and these outside of limits, shall not be damaged. Top soil and vegetable matter shall be carefully stockpiled and preserved for surfacing completed slopes.

3.02 PREPARATION

- A. Site Inspection: Walk site with Engineer to confirm clearing limits, protected areas, and disposal methods.
- B. Protection:
 - 1. Install temporary fencing or flagging around trees, wetlands, or features designated to remain, per drawings or local buffer requirements (e.g., 25-foot stream buffer per Georgia EPD).
 - 2. Protect utilities with barriers or hand-clearing within 5 feet, as directed by Engineer.
 - 3. Permits:
 - a. Post Land Disturbance Permit where required by Local Authority.
 - b. Ensure that a copy of the Notice of Intent for the Storm Permit is present at the site and that it was submitted 14 days prior to the clearing activity.
 - c. Ensure that a copy of the approved Erosion and Sediment Control Plan (E&SC) is present at the site.
- C. Install initial Erosion and Sediment Control BMPs per the approved E&SC plan and as specified in Section 31 25 00.

3.03 CLEARING

- A. Extent: Clear all vegetation, trees, shrubs, and debris within limits shown on drawings or as staked in field.
- B. Methods:

1. Use mechanized equipment (e.g., bulldozers, brush cutters) for large areas; hand-clear near protected features.
2. Cut trees and shrubs flush with ground or as specified; remove stumps per grubbing requirements.

C. Tree Removal:

1. Fell trees to avoid damage to adjacent structures or vegetation to remain.
2. Comply with local tree ordinances where applicable.

3.04 GRUBBING

- A. Remove stumps, roots, and organic material to a depth of 12 inches below subgrade or as specified, within paved or structural areas.
- B. Backfill depressions with compacted fill material to match surrounding grade; compact to 95% maximum density (ASTM D698).
- C. Leave undisturbed areas outside construction limits unless otherwise directed.

3.05 DEBRIS REMOVAL AND DISPOSAL

A. Disposal:

1. Remove all cleared materials from site and dispose of legally at licensed facilities (e.g., landfills or mulch yards).
2. Burning prohibited unless permitted by Georgia Forestry Commission and local authorities; comply with air quality rules (Georgia Rule 391-3-1).
3. Chipping: Chip small branches and vegetation for mulch if directed; stockpile or dispose as specified.
4. Hazardous Materials: Report and segregate unexpected debris (e.g., concrete, metal) for Engineer's direction

3.06 FIELD QUALITY CONTROL

- A. Verify clearing limits and protected areas daily; adjust operations if discrepancies arise.
- B. Ensure no damage to features designated to remain; repair at contractor's expense if damaged.

3.07 CLEANUP

- A. Remove equipment, temporary protections, and remaining debris upon completion.
- B. Leave site ready for grading or subsequent construction activities.

END OF SECTION

SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Excavation, grading, filling, and compaction of earth materials for site preparation, including cut and fill operations, embankment construction, and rough grading.
2. Related activities include learing, stockpiling, erosion control, and disposal of unsuitable materials.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 40 00 - Quality Requirements
2. Section 31 10 00 - Site Clearing
3. Section 31 23 00 – Excavation and Fill for Structures
4. Section 31 23 63 – Rock Blasting
5. Section 31 23 33 – Trenching and Backfilling Utilities
6. Section 31 25 00 – Erosion and Sediment Control
7. Section 32 11 23 – Aggregate Base Course
8. Section 32 92 00 – Turf and Grasses

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
3. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes
4. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

5. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods

B. Occupational Safety and Health Administration (OSHA):

C. 29 CFR Part 1926 - Safety and Health Regulations for Construction

1.04 DEFINITIONS

A. Rock: Those materials in the original bed and in well-defined ledges which, in the opinion of the Engineer, cannot be removed with pick, shovel, ditching machine, $\frac{5}{8}$ cubic yard backhoe and other similar devices, and which requires jack hammering with bull point or drilling and blasting. Boulders, and detached pieces of rock, having volumes of more than 8 cubic feet, shall be considered as rock

B. Suitable Material: Where the term suitable material is used in specification sections pertaining to earthwork, it means earth materials designated as suitable for their intended use by the soils technician or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CL or as designated in these specifications.

C. Underlayment: Aggregate layer placed over excavated subgrade and below structural slabs and footings for subgrade stabilization.

D. Unsuitable Material: Excavated material that is unsuitable for backfill or other intended use and as classified by the soil technicians. In addition to organic matter, sod, muck, roots, and rubbish, highly plastic clay of the CH and MH descriptions and organic soils of the OL, OH, and PT descriptions, as defined in the Unified Soil Classification System, shall be considered unsuitable material.

1.05 SUBMITTALS

A. Product Data:

1. Geotextile fabrics
2. Imported fill materials

B. Test Reports:

1. Soil classification
2. Compaction testing
3. Material gradation analysis

C. Work Plan:

1. Excavation methods
2. Dewatering procedures
3. Compaction equipment

4. Safety systems

1.06 MATERIAL CLASSIFICATION FOR PAYMENT

- A. Unless a unit price for rock excavation is included on the Bid Form, Section 00 41 00, no classification of excavated materials will be made. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

1.07 MATERIAL TESTING

- A. Geotechnical Testing
 - 1. Tests for compaction and density shall be conducted by an independent testing laboratory.
 - 2. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests.
 - 3. Costs of compaction tests shall be paid for by the Owner. Contractor shall pay for retesting due to failed test.

1.08 QUALITY ASSURANCE

- A. Contractor's Qualifications:
 - 1. Minimum 5-years experience in earth moving and grading projects of similar scope.
 - 2. Contractor must be a licensed Utility Contractor and work must be overseen by licensed Utility Foreman.
- B. Geotechnical Testing Agency Qualifications:
 - 1. Geotechnical testing to be provided by the Owner
- C. Regulatory Requirements:
 - 1. Notify Georgia 811 "Call Before You Dig" or submit online dig ticket a minimum of 3 days prior to beginning excavations. Contractor shall adhere to all responses to the dig ticket. Utility service permits shall be kept current for the extent of the work covered.
 - 2. All required land disturbance, encroachment or other required permits must be obtained prior to beginning excavation and copies kept at the project site.
 - 3. All work shall comply with local codes and ordinances.
 - 4. Comply with OSHA requirements for trench safety

1.09 PROJECT CONDITIONS

- A. Any applicable Subsurface Investigation, if conducted on the project, will be provided in the Appendices.

1. The conditions identified in the Geotechnical Report shall not constitute special conditions. Any subsurface condition identified in the Geotechnical Report but not specifically identified in the contract documents shall be unclassified.
- B. Contours and existing topography shown on the Drawings are believed to be reasonably correct. It shall be the Bidder's responsibility to determine any major difference which would affect his bid and make allowance for such differences in his bid.
- C. Errors by automated grading equipment, whether caused by existing conditions or inaccurate survey shall be remedied at the Contractor's expense.
- D. Weather Limitations:
 1. To the extent practical, excavations and filling operations shall be performed during dry conditions
 2. Open excavations and spoil piles to be used for backfill shall be protected during rain

PART 2 - PRODUCTS

2.01 FILL MATERIALS

- A. Structural fill: Refer to Specification Section 31 23 00, Excavation and Fill for Structures.
- B. Select Fill:
 1. Granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification system types SW, SM, GW, or GM or as otherwise approved by the Engineer as select fill. Select fills shall contain no stones or rubbles larger than 1½ " in diameter.
- C. Common Fill (General Grading)
 1. Native or imported soil material, suitable for compaction, free of organic matter and rocks greater than 6 inches.
 2. Soils determined to be "Unsuitable", as defined in these specifications shall not be used for Common Fill unless otherwise approved by the soil technician or Engineer.
- D. Topsoil
 1. Fertile, friable loam, conforming to the Unified Soil Classification system types USCS, ML, or SM
 2. Typical properties are pH of 6.0-7.0, organic content between 2-5%
 3. Free of rocks or clods greater than 1".
 4. Top soil may be salvaged from the site or imported.
- E. Questions of suitability of proposed fill or backfill shall be addressed by the Testing Agency's representative.

2.02 GEOTEXTILES

A. Construction/Separation Fabric:

1. Construction fabric shall be a polyester continuous filament needle punched nonwoven engineering fabric such as Mirafi 500X as manufactured by Celanese, Inc. or equal.

B. Nonwoven Geotextile Fabric (For use where required)

1. Minimum grab tensile strength: 200 lbs
2. UV resistant

C. Filter Fabric:

1. Woven geotextile
2. Apparent opening size: #70 sieve
3. Permittivity: 0.2 sec^{-1} minimum

PART 3 - EXECUTION

3.01 CLEARING

- #### A. Clearing for Utility excavations shall be in accordance with Section 31 10 00 Site Clearing

3.02 PREPARATION

A. Regulatory:

1. Ensure Land Disturbance Permit has been issued and a copy of the approved plans are on site.
2. NOI for coverage under the General Permit GAR100001, GAR100002, or GAR100003, as applicable to the project, must be filed 14 days prior to any land disturbing activities.

B. Site Preparation:

C. Protection:

1. Contractor shall protect existing nearby structures from damage during excavation.
2. Existing utilities shall be properly supported or shored to prevent damage during construction.
3. Erosion and Sediment controls shall be installed per the approved plans prior to beginning excavation.

D. Layout:

1. Mark utility locations
2. Establish line and grade

- 3. Set offset stakes
- 3.03 STRUCTURAL EXCAVATIONS
 - 1. Refer to Specification Section 31 23 00, Excavation and Fill for Structures
- 3.04 TRENCHING FOR PIPELINES AND OTHER UTILITIES
 - 1. Refer to Specification Section 31 23 33, Trenching and Backfilling Utilities
- 3.05 TOP SOIL STRIPPING
 - A. Topsoil shall be stripped from all areas to be graded, prior beginning rough grading.
 - B. Strip topsoil to a depth specified in geotechnical report or drawings. If depth is not specified, the organic topsoil, A-Horizon, as defined in the Products Section of this Specification, shall be removed.
 - C. Use dozers, scrapers, or graders to carefully remove topsoil without mixing with the subsoil.
 - D. Stripped topsoil shall be stockpiled and protected for final placement after completion of Finish Grading
- 3.06 ROUGH GRADING
 - A. General Requirements:
 - 1. Before the beginning of construction operations, the Contractor will rough grade the site to the proposed elevations as indicated on the Drawings. Cut and fill shall be balanced as close as practicable.
 - 2. Permanent slopes should not exceed 3H:1V unless noted otherwise on the drawings.
 - 3. Soil stockpiles shall be located as shown on the drawings or as directed by the Engineer.
 - 4. Ensure positive drainage for all cut or fill areas.
 - 5. Shape site to approximate design contours after excavation and fill, within ± 0.1 feet of design elevations. Grades shall be verified by survey at 100 grid, minimum, and at all critical transition points. Rough grade elevations shall account for depth of any aggregate, pavements, topsoil, etc. required to accomplish final grade.
 - 6. Site grading may be accomplished by any customary equipment or methods.
 - B. Excavation
 - 1. The Contractor shall perform all excavating of every description, and of whatever substances encountered.
 - 2. Unsuitable material shall be removed from excavations and replaced with suitable fill when required.
 - 3. Rock Excavation:

- a. Rock encountered during excavation shall be removed and disposed of off-site unless directed otherwise by the Engineer.
- b. Rock shall be removed by ripping, hammering, or blasting when required.
 - 1) Blasting must received prior approval from the Engineer.
 - 2) If allowed, blasting shall be in accordance with Section 31 23 63 Rock Blasting.
- c. Where rock is encountered at the proposed final grade, the area should be undercut a minimum of 12" and replaced with suitable fill material.

C. Fill and Compaction:

- 1. All fills shall be of suitable material obtained from the site and compacted as follows to form an unyielding sub-base.:
 - a. For compaction under pavements and structures, refer to Specification Section 31 23 00, Excavation and Fill for Structures.
 - b. Yard Fills, non-loaded areas, compact to 90% Standard Proctor (ASTM D698).
- 2. Where the quantity or suitability of onsite fill is not adequate to achieve proposed grade, the Contractor shall import suitable material. The cost of imported fill shall be included in the site grading price unless an extra work item is included on the Bid Form.

3.07 FINISH GRADING

- A. Finish grading shall refine the rough grading with ± 0.05 feet tolerance. Grades shall be verified by survey at 50 grid, minimum, and at all critical transition points
- B. Finish grade elevations shall account for depth of any aggregate, pavements, topsoil, etc. required to accomplish final grade.
- C. Unless noted otherwise on the drawings, final grade at buildings shall be a minimum of 4" below finished floor.
- D. Finish grade shall provide smooth transitions between cut/fill interfaces, slopes, and drainage swales.
- E. The Finish grade shall provide a uniform surface free of rocks or other irregularities greater than 1".

3.08 TOPSOILING

- A. After achieving finish grade, place stockpiled topsoil over areas designated for landscaping and seeding.
- B. The finish grade shall be scarified approximately 2" in depth to bond topsoil.
- C. Topsoil shall be placed to a 4-6" uniform depth or as otherwise noted on the drawings.
- D. Spread topsoil using dozers or spreaders, avoiding compaction; place in one lift for depths ≤ 6 inches.

- E. Lightly roll to 85% standard Proctor (ASTM D698) to settle without over-compacting, preserving soil structure for planting.
- F. Cover with mulch or seed within 7 days to prevent erosion and loss of topsoil.

3.09 ROAD SHOULDER

- A. Road shoulders shall be constructed of select material or topsoil in accordance with typical sections shown, and shall be grassed as specified elsewhere.
- B. Local quarry waste material may be used for base material meeting Section 310 of Highway Specifications, except for material passing No. 60 sieve which may be from 15 to 85 percent.
 - 1. Prevent sediment discharge into waterways or adjacent properties.

3.10 DISPOSAL OF MATERIAL

- A. Excess spoil material and rock shall be disposed of offsite at the Contractor's expense unless a designated spoil area is noted on the Drawings.
- B. All waste materials shall be disposed of in accordance with applicable state and local regulations.
- C. Excess Topsoil shall be spread evenly onsite in areas approved by the Engineer or stockpiled for future use.

3.11 FIELD QUALITY CONTROL

- A. Compaction Testing:
 - 1. One test per 5,000 square feet per lift, minimum
 - 2. Minimum 2 test per day.
 - 3. Test Methods:
 - a. In-place density: ASTM D6938
 - b. Moisture content: ASTM D6938
 - c. Compaction: ASTM D1557
 - 4. Acceptance Criteria:
 - a. Density within 2% of specification
 - b. Moisture within 2% of optimum
 - c. No visible settlement

3.12 SAFETY

- A. Excavations shall be in accordance with OSHA requirements to allow for safe installation and inspection. Sidewalls shall be stabilized by sloping, shoring, or shielding systems where required.

- B. An OSHA certified “Competent Person” must be present during all excavation and backfill activities.
- C. Excavated materials shall be placed in a manner that will not obstruct work nor endanger the workers, obstruct roads or walkways.

3.13 PROTECTION

- A. Excavated material shall not be placed along highways, streets, and roadways in such a manner as to obstruct traffic.
- B. Construct berms or swales as required to prevent excess runoff.
- C. Contractor shall utilize approved traffic control methods where required along public rights-of-way.

3.14 CLEAN UP AND DUST CONTROL

- A. The Contractor shall furnish a road grader, which shall be available for use at all times, for maintaining highways, streets, and roadways upon which work is being performed. All such highways, streets, and roadways shall be maintained in suitable condition for movement of traffic until completion and final acceptance of the work.

3.15 REPAIR:

- A. Contractor shall correct any settlement immediately by a combination of removing soft or inadequately compacted material, refilling, and compacting or other methods approved by the engineer.
- B. Any damage to existing roads, walks, structures, or other similar shall be repaired by the contractor.

END OF SECTION

SECTION 31 23 00

EXCAVATION AND FILL FOR STRUCTURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Excavation, backfill, and compaction for structures, including buildings, utility structures, retaining walls, slabs on grade, and other similar.
2. Excavation, backfill, and compaction beneath roadways, drives, and parking areas.
3. Related activities include grading, dewatering, and disposal of unsuitable material.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 40 00 - Quality Requirements
2. Section 31 10 00 Site Clearing
3. Section 31 20 00 - Earth Moving
4. Section 31 23 63 – Rock Blasting
5. Section 31 31 00 – Soil Treatment
6. Section 31 23 33 – Trenching and Backfilling Utilities
7. Section 32 11 23 – Aggregate Base Course
8. Section 32 12 16 – Asphalt Paving

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
3. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes
4. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

5. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods

B. Occupational Safety and Health Administration (OSHA):

C. 29 CFR Part 1926 - Safety and Health Regulations for Construction

1.04 DEFINITIONS

A. Rock: Those materials in the original bed and in well-defined ledges which, in the opinion of the Engineer, cannot be removed with pick, shovel, ditching machine, $\frac{5}{8}$ cubic yard backhoe and other similar devices, and which requires jack hammering with bull point or drilling and blasting. Boulders, and detached pieces of rock, having volumes of more than 8 cubic feet, shall be considered as rock

B. Subgrade: The uppermost surface of an excavation, including excavation for trenches, or the top surface of a fill or backfill immediately below base course, pavement, or topsoil materials.

C. Suitable Material: Where the term suitable material is used in specification sections pertaining to earthwork, it means earth materials designated as suitable for their intended use by the soils technician or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CL or as designated in these specifications.

D. Underlayment: Aggregate layer placed over excavated subgrade and below structural slabs and footings for subgrade stabilization.

E. Unsuitable Material: Excavated material that is unsuitable for backfill or other intended use and as classified by the soil technicians. In addition to organic matter, sod, muck, roots, and rubbish, highly plastic clay of the CH and MH descriptions and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System, shall be considered unsuitable material.

1.05 SUBMITTALS

A. Product Data:

1. Geotextile fabrics
2. Imported fill materials

B. Test Reports:

1. Soil classification
2. Compaction testing
3. Material gradation analysis

C. Work Plan:

1. Excavation methods
2. Dewatering procedures

3. Compaction equipment

4. Safety systems

1.06 MATERIAL CLASSIFICATION FOR PAYMENT

- A. Unless a unit price for rock excavation is included on the Bid Form, Section 00 41 00, no classification of excavated materials will be made. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

1.07 MATERIAL TESTING

A. Geotechnical Testing

1. Tests for compaction and density shall be conducted by an independent testing laboratory.
2. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests.
3. Costs of compaction tests shall be paid for by the Owner. Contractor shall pay for retesting due to failed test.

1.08 QUALITY ASSURANCE

A. Contractor's Qualifications:

1. Minimum 5-years experience in structural excavations and fill placement
2. Contractor must be a licensed Utility Contractor and work must be overseen by licensed Utility Foreman.

B. Geotechnical Testing Agency Qualifications:

1. Independent testing laboratory must be approved by the Engineer.
2. Geotechnical agency must be qualified according to ASTM D3740
3. Geotechnical agency must have a minimum of 5-years experience in soil testing.

C. Regulatory Requirements:

1. Notify Georgia 811 "Call Before You Dig" or submit online dig ticket a minimum of 3 days prior to beginning excavations. Contractor shall adhere to all responses to the dig ticket. Utility service permits shall be kept current for the extent of the work covered.
2. All required land disturbance, encroachment or other required permits must be obtained prior to beginning excavation and copies kept at the project site.
3. All work shall comply with local codes and ordinances.
4. Comply with OSHA requirements for trench safety

1.09 PROJECT CONDITIONS

- A. Any applicable Subsurface Investigation, if conducted on the project, will be provided in the Appendices.
 - 1. The conditions identified in the Geotechnical Report shall not constitute special conditions. Any subsurface condition identified in the Geotechnical Report but not specifically identified in the contract documents shall be unclassified.
- B. The Contractor's attention is directed to Article 5, Section 00 21 13, Instructions to Bidders, relating to Site Examination.
- C. Contours and existing topography shown on the Drawings are believed to be reasonably correct. It shall be the Bidder's responsibility to determine any major difference which would affect his bid and make allowance for such differences in his bid.
- D. Errors by automated grading equipment, whether caused by existing conditions or inaccurate survey shall be remedied at the Contractor's expense.
- E. Weather Limitations:
 - 1. To the extent practical, excavations and filling operations shall be performed during dry conditions
 - 2. Open excavations and spoil piles to be used for backfill shall be protected during rain

PART 2 - PRODUCTS

2.01 FOUNDATION STABILIZATION STONE AND UNDERLAYMENT

- A. Stone for foundation stabilization and underlayments shall be well graded crushed stone two inches or smaller in size. Gradations #57, #67, and #5 are acceptable.

2.02 STRUCTURAL FILL

- A. Structural Fill shall be clean inorganic natural soil. Soils proposed for fill shall have a maximum density of 98 pounds per cubic foot or greater in Standard Proctor Compaction Test ASTM D698.
- B. Structural fill below building areas (and the upper 2 feet of fill beneath pavements) shall contain no rock fragments larger than 3-inches in longest dimension.
- C. Excavated materials which contain large quantities of rock or weathered rock fragments shall not be used in building areas.
- D. Fill below floors, foundations and paved areas shall be compacted at least 98% of the ASTM D698 maximum density

2.03 SELECT MATERIAL:

- A. Granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification System types SW, SM, GW, or GM or as otherwise approved by the Engineer as select fill. Select fills shall contain no stones or rubbles larger than 1½ " in diameter.

2.04 GEOTEXTILES

A. Construction/Separation Fabric:

1. Construction fabric shall be a polyester continuous filament needle punched nonwoven engineering fabric such as Mirafi 500X as manufactured by Celanese, Inc. or equal.

B. Nonwoven Geotextile Fabric (For use where required)

1. Minimum grab tensile strength: 200 lbs
2. UV resistant

C. Filter Fabric:

1. Woven geotextile
2. Apparent opening size: #70 sieve
3. Permittivity: 0.2 sec^{-1} minimum

PART 3 - EXECUTION

3.01 CLEARING

- A. Clearing for Utility excavations shall be in accordance with Section 31 10 00 Site Clearing

3.02 PREPARATION

A. Site Preparation:

B. Protection:

1. Contractor shall protect existing nearby structures from damage during excavation.
2. Existing utilities shall be properly supported or shored to prevent damage during construction.
3. Erosion and Sediment controls shall be installed per the approved plans prior to beginning excavation.

C. Layout:

1. Mark utility locations
2. Establish line and grade
3. Set offset stakes

3.03 STRUCTURAL EXCAVATION

A. General Requirements:

1. The Contractor shall perform all excavating of every description, and of whatever substances encountered, to the dimensions and levels shown on the Drawings and/or as specified. Excavation may be accomplished by any customary method.

2. Unsuitable material shall be removed from the excavation and replaced with suitable fill when required.

B. Earth Excavation

1. Earth excavation for structures shall be to limits not less than 2-feet outside wall lines, to allow for formwork and inspection; and further, as necessary, to permit the trades to install their work.
2. Excavations for footings shall be to footing dimensions. Excavation for slabs shall be to near bottom slab level.

C. Rock Excavation for Structures:

1. Rock excavations for structures shall be to limits not less than 2-feet outside of wall lines, with a vertical tolerance of 3-inches in or out, and further if necessary to allow for inspection and to permit trades to install their work. Excavation for footings shall be to a minimum depth and width not less than the footing dimensions. Excavation for slabs shall be not higher than bottom slab level.
2. Blasting:
 - a. Blasting operations shall be allowed only with prior approval of the Engineer.
 - b. If allowed, blasting shall be in accordance with Section 31 23 63 Rock Blasting.

3.04 FOUNDATION SUBGRADE STABILIZATION

- A. The Contractor shall place crushed stone stabilization layers under foundations and slabs in excavations, unless otherwise shown on the Drawings, and/or where soil conditions at foundation elevations are unsuitable for construction of foundations.
1. 6" minimum aggregate underlayment is required beneath all structures and slabs on grade unless noted otherwise.
- B. The subgrade conditions shall be inspected by an experienced soils technician and stabilization stone placed in accordance with his recommendations.
- C. Payment for crushed stone stabilization **not shown on the drawing and where ordered by the Engineer**, will be made in accord with the unit price bid for the item under "Extra Work," measured before placing and shall include the removal and disposal of unsuitable subgrade materials.

3.05 DEWATERING

A. Implementation:

1. The site shall be kept free of surface water at all times. The Contractor shall install drainage ditches and dikes and shall perform all pumping and other work necessary to divert or remove rainfall and all other accumulations of surface water from the excavations.
2. The diversion and removal of surface water shall be performed in a manner that will prevent the accumulation of water behind temporary structures or at any other locations within the construction area where it may be detrimental.

3. The Contractor shall provide, install and operate sufficient trenches, sumps, pumps, hose, piping, wellpoints, deep wells, etc., necessary to depress and maintain the ground water level at least 3' below the base of the excavation during all stages of construction operations. The ground water table shall be lowered in advance of excavation and maintained a minimum of 3' feet below the lowest excavation subgrade made until $\frac{1}{8}$ the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures.

B. Discharge:

1. Direct water pumped from sumps or well points to silt bags, settling basins, or approved drainage; comply with local permits.
2. Prevent sediment discharge into waterways or adjacent properties.

3.06 CRUSHED STONE STABILIZATION

- A. Wherever the subgrade is by nature too soft or mucky for the proper installation of the pipe or other utilities, in the opinion of the Engineer, he may order the Contractor to undercut the trench and backfill with crusher run stone or crushed stone $\frac{3}{4}$ " in size and less. The stone shall be brought to the subgrade required by the class of bedding for the particular location and compacted. All unsuitable excavated material must be properly disposed of in a manner acceptable to the Owner in a manner that will not adversely impact the environment.
- B. Payment for crushed stone stabilization, only where ordered by the Engineer, will be made in accord with the unit price bid for the item under "Extra Work," measured before placing and shall include the removal and disposal of unsuitable subgrade materials.

3.07 STRUCTURAL FILL

- A. After excavation operations have been completed, all structure locations shall be proof-rolled with a loaded pan or heavy pneumatic tired vehicle to densify upper soils and to locate possible areas which will require undercutting, removal and/or recompaction. This operation shall be conducted under the surveillance of an experienced soil inspector.
- B. Compaction
 1. Structural fill shall be placed in loose layers 8-inches or less in thickness unless noted otherwise elsewhere in these specifications.
 2. Moisture content of structural fill material shall be $\pm 2\%$ of optimum.
 3. Each layer shall be compacted by sheeps foot or rubber tired roller operating independently of the dozer used to spread fill. If the fill soils are clayey or silty sands or sandy silts with Unified Classifications of SC, SM, SP or ML, the compaction of each fill layer shall be completed by two (2) coverage's of rolling with a loaded earth moving scraper, dump truck or large rubber tired roller before more fill is placed.
 4. Compaction requirements:
 - a. Compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698 (Standard Proctor).

- 1) Existing in place sub-grade below structures where subgrade has been disturbed by water, improper dewatering, or construction activities: 98%
 - 2) Fill beneath structures and beneath an area extending 10 feet beyond the limits of the foundation: 98%
 - 3) Compaction of suitable material used to replace unsuitable material below foundation subgrades: 98%
5. Where indicated on the drawings, provide select granular material.

C. Testing:

1. Fill compaction shall be verified by field density testing conducted throughout the period of fill placement and compaction. Subgrade preparation shall be inspected by an experienced soil engineer. Field density tests shall be performed to verify that the specified degree of compaction is achieved.
2. For building areas, a frequency of passing tests of at least 1 test per 1500 square feet for each 18- inches of new fill thickness is required.

D. Construction Fabric:

1. Contractor shall furnish and install, where indicated on the drawings or in these specifications, construction fabric to stabilize soil surfaces for structural fill placement.

3.08 BACKFILLING AROUND STRUCTURES

A. Backfill excavations as promptly as progress of work permits, but not until completion of the following:

1. Inspection and acceptance of construction below finish grade including, where applicable, foundation drains, damp proofing, and waterproofing.
2. Inspection, testing, and recording locations of underground utilities.
3. Leakage test on water containing structures.
4. Removing concrete form work, shoring and bracing, and all trash and debris.
5. Foundation walls have been in place a minimum of seven days.

B. Placing and Compacting

1. Place backfill and fill materials in layers not more than 8" in loose depth (6" max. compacted depth).
2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content within 2%.
3. Compact each layer to at least 95% Standard Proctor (ASTM D698).
4. Do not place backfill material on surfaces that are muddy, frozen, or containing frost or ice.
5. Place backfill material evenly adjacent to structures to the required elevations.

6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
7. Do not operate heavy equipment closer to foundation or retaining walls than a distance equal to the height of backfill above the footing. Compact remaining areas using power driven hand tampers.
8. Where the construction includes basement or other underground walls having structural floors above them, do not backfill such walls until the structural floors are in place and have attained sufficient strength to support the walls.

3.09 EXCAVATION AND FILL FOR ROADWAYS AND WALKS

A. Excavation

1. Excavation for roadways and walks shall be made to the lines, grades and typical sections shown.
2. Proper allowances shall be made for specified thickness of roadbed and walkway below the finish grade shown.
3. Should rock be encountered in the subgrade, the road shall be excavated to a depth of six (6") inches below subgrade and the resulting space backfilled with suitable material.

B. Fill

1. Fill under roadways and walks shall be as defined in the "Structural Fill" Section to 98% Standard Proctor (ASTM D698).

3.10 DISPOSAL OF MATERIAL

- A. Excess spoil material shall be disposed of offsite at the Contractor's expense unless a designated spoil area is noted on the Drawings.
- B. All waste materials shall be disposed of in accordance with applicable state and local regulations.

3.11 FIELD QUALITY CONTROL

A. Testing:

1. One test per 100 linear feet per lift
2. One test per structure
3. Additional tests as directed

B. Test Methods:

1. In-place density: ASTM D6938
2. Moisture content: ASTM D6938
3. Compaction: ASTM D1557

C. Acceptance Criteria:

1. Density within 2% of specification
2. Moisture within 2% of optimum
3. No visible settlement

3.12 SAFETY

- A. Excavations shall be in accordance with OSHA requirements to allow for safe installation and inspection. Sidewalls shall be stabilized by sloping, shoring, or shielding systems where required.
- B. An OSHA certified "Competent Person" must be present during all excavation and backfill activities.
- C. Ladders or ramps must be provided for inspection access per OSHA requirements.
- D. Excavated materials shall be placed in a manner that will not obstruct work nor endanger the workers, obstruct roads or walkways.

3.13 PROTECTION

- A. Excavated material shall not be placed along highways, streets, and roadways in such a manner as to obstruct traffic.
- B. Construct berms or swales as required to prevent the entry off excess runoff into trenches.
- C. Grade excavation bottoms to prevent ponding.
- D. Contractor shall utilize approved traffic control methods where required along public rights-of-way.

3.14 CLEAN UP

- A. The Contractor shall furnish a road grader, which shall be available for use at all times, for maintaining highways, streets, and roadways upon which work is being performed. All such highways, streets, and roadways shall be maintained in suitable condition for movement of traffic until completion and final acceptance of the work.
- B. Repair:
 1. Correct settlement immediately
 2. Repair surface damage
 3. Maintain until final acceptance

END OF SECTION

SECTION 31 23 33

TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for excavation, trenching, and backfilling for:

1. Underground utilities
2. Pipeline installations
3. Structure foundations
4. Site grading
5. Drainage systems

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 40 00 - Quality Requirements
2. Section 31 10 00 - Site Clearing
3. Section 31 20 00 - Earth Moving
4. Section 31 23 00 – Excavation and Fill of Structures
5. Section 31 23 63 – Blasting
6. Section 31 25 00 – Erosion and Sediment Control
7. Section 33 05 05 – Buried Pipe Installation
8. Section 33 05 07 – Trenchless Installation of Utility Pipe

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
3. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes

- 4. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - 5. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
 - B. Occupational Safety and Health Administration (OSHA):
 - C. 29 CFR Part 1926 - Safety and Health Regulations for Construction
- 1.04 DEFINITIONS
- A. Backfill: Soil material used to fill excavation
 - 1. Initial Backfill: Backfill placed beside and over pipe
 - 2. Final Backfill: Backfill placed over initial backfill
 - B. Bedding Course: Aggregate layer placed over excavated subgrade
 - C. Rock: Those materials in the original bed and in well-defined ledges which, in the opinion of the Engineer, cannot be removed with pick, shovel, ditching machine, $\frac{5}{8}$ cubic yard backhoe and other similar devices, and which requires jack hammering with bull point or drilling and blasting. Boulders, and detached pieces of rock, having volumes of more than 8 cubic feet, shall be considered as rock
 - D. Subgrade: The uppermost surface of an excavation, including excavation for trenches, or the top surface of a fill or backfill immediately below base course, pavement, or topsoil materials.
 - E. Utility: Any buried pipe, duct, conduit, or cable
 - F. Unsuitable Material: Excavated material that is unsuitable for backfill
- 1.05 SUBMITTALS
- A. Product Data:
 - 1. Geotextile fabrics
 - 2. Imported fill materials
 - 3. Warning tape
 - B. Test Reports:
 - 1. Soil classification
 - 2. Compaction testing
 - 3. Material gradation analysis
 - C. Work Plan:
 - 1. Excavation methods

2. Dewatering procedures
3. Compaction equipment
4. Safety systems

1.06 MATERIAL CLASSIFICATION FOR PAYMENT

- A. Unless a unit price for rock excavation is included on the Bid Form, Section 00 41 00, no classification of excavated materials will be made. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

1.07 MATERIAL TESTING

A. Geotechnical Testing

1. Tests for compaction and density shall be conducted by an independent testing laboratory.
2. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests.
3. Costs of compaction tests shall be paid for by the Owner. This will also include all retests made necessary by the failure of materials to conform to the requirements of these Contract Documents

1.08 QUALITY ASSURANCE

A. Contractor's Qualifications:

1. Minimum 5-years experience in buried pipe installation
2. Successfully completed at least 3 similar projects in past 2 years
3. Contractor must be a licensed Utility Contractor and work must be overseen by licensed Utility Foreman.

B. Geotechnical Testing Agency Qualifications:

1. Independent testing laboratory must be approved by the Engineer.
2. Geotechnical agency must be qualified according to ASTM D3740
3. Geotechnical agency must have a minimum of 5-years experience in soil testing.

C. Regulatory Requirements:

1. Notify Georgia 811 "Call Before You Dig" or submit online dig ticket a minimum of 3 days prior to beginning excavations. Contractor shall adhere to all responses to the dig ticket. Utility service permits shall be kept current for the extent of the work covered.
2. All required land disturbance, encroachment or other required permits must be obtained prior to beginning excavation and copies kept at the project site.
3. All work shall comply with local codes and ordinances.

4. Comply with OSHA requirements for trench safety

1.09 PROJECT CONDITIONS

A. Weather Limitations:

1. To the extent practical, excavations and filling operations shall be performed during dry conditions
2. Open excavations and spoil piles to be used for backfill shall be protected during rain

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General Fill:

1. Free of debris and organic material
2. Maximum particle size: 6 inches
3. Approved by geotechnical engineer

B. Structural Fill:

1. Well-graded granular material
2. Maximum particle size: 3 inches
3. Less than 12% passing #200 sieve
4. Plasticity index less than 10

C. Pipe Bedding:

1. Clean sand or crushed stone or as otherwise noted, scheduled or specified.
2. Maximum particle size: 3/4 inch
3. Free draining

D. Initial Backfill:

1. Similar to bedding material
2. Free of sharp objects
3. Suitable for pipe protection

2.02 CLASSIFICATION OF BEDDING AND BACKFILL MATERIAL

A. Materials for bedding and backfill shall be classified as follows:

1. Class I: Angular ¼" to ¾" graded stone. Latest revision of ASTM C 33 - Gradation #67 (ASTM #67) or #57 (ASTM #57) are acceptable.
2. Class II: Coarse sands and gravels with maximum particle size of ¾" including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.
3. Class III: Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures.
4. Class IV: Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.
5. Class V: Organic soils as well as soils containing frozen earth, debris, rocks larger than 1½" in diameter and other foreign materials. **Class V soils shall not be used for bedding or backfill unless directed otherwise by the Engineer.**

2.03 GEOTEXTILES

A. Construction/Separation Fabric:

1. Construction fabric shall be a polyester continuous filament needle punched nonwoven engineering fabric such as Mirafi 500X as manufactured by Celanese, Inc. or equal.

B. Nonwoven Geotextile Fabric (For use where required)

1. Minimum grab tensile strength: 200 lbs
2. UV resistant

C. Filter Fabric:

1. Woven geotextile
2. Apparent opening size: #70 sieve
3. Permittivity: 0.2 sec⁻¹ minimum

PART 3 - EXECUTION

3.01 CLEARING

- A. Clearing for Utility excavations shall be in accordance with Section 31 10 00 Site Clearing

3.02 PREPARATION

A. Site Preparation:

B. Protection:

1. Contractor shall protect existing nearby structures from damage during excavation.

2. Existing utilities shall be properly supported or shored to prevent damage during construction.
3. Erosion and Sediment controls shall be installed per the approved plans prior to beginning excavation.

C. Layout:

1. Mark utility locations
2. Establish line and grade
3. Set offset stakes

3.03 EXCAVATION

A. General Requirements:

1. Trenches shall be excavated to required line and grade shown on the drawings.
2. Unsuitable material shall be removed from the trench and replaced with suitable fill when required.

B. Trench Width: Refer to other Sections

C. Depth:

1. Trenches shall be constructed to the depths required for minimum cover or elevations noted on the Drawings plus the required bedding depth.

3.04 ROCK EXCAVATION

A. Rock Excavation for Pipe Lines:

1. Where excavation of rock, boulders or large stones is required, a clearance of not less than 6" in every direction from all parts of pipe and appurtenances shall be provided.
2. Where rock is encountered at grade in trenches, the trench shall be excavated not less than 6" below the bottom of the pipe bell, refilled with crushed stone thoroughly tamped in-place, and shaped to the pipe. No additional payment will be made for crushed stone bedding in rock excavation; the cost shall be included in the unit price stated for rock excavation.
3. Excavated rock shall not be mixed with material selected for tamped backfilling under and around the pipe up to a level at least 2' above the pipe.

B. Blasting:

1. Blasting operations shall be allowed only with prior approval of the Engineer.
2. If allowed, blasting shall be in accordance with Section 31 23 63 Rock Blasting.

C. Payment

3.05 DEWATERING

A. Implementation:

1. Maintain dry trench conditions during bedding and pipe installation using pumps, well points, or sumps.
2. Ground water should generally be kept 12-18 inches below trench bottom.
3. If, in the opinion of the Engineer, the Contractor has failed to obtain an absolutely dry trench bottom by insufficient use of all known methods of trench dewatering, the Engineer may order the Contractor to excavate below grade and place not less than 6" of graded crushed stone fill material over the trench bottom to form trench drains to suitable located sumps and the water removed by bailing or pumping. The graded crushed stone fill material shall be placed at the Contractor's own expense and shall be of such depth that there shall be no water in bell holes at the time of coupling pipe. All unsuitable excavated material must be properly disposed of in a manner acceptable to the Engineer and in a manner that will not adversely impact the environment.

B. Discharge:

1. Direct water to silt bags, settling basins, or approved drainage; comply with local permits.
2. Prevent sediment discharge into waterways or adjacent properties.

3.06 CRUSHED STONE STABILIZATION

- A. Wherever the subgrade is by nature too soft or mucky for the proper installation of the pipe or other utilities, in the opinion of the Engineer, he may order the Contractor to undercut the trench and backfill with crusher run stone or crushed stone $\frac{3}{4}$ " in size and less. The stone shall be brought to the subgrade required by the class of bedding for the particular location and compacted. All unsuitable excavated material must be properly disposed of in a manner acceptable to the Owner in a manner that will not adversely impact the environment.
- B. Payment for crushed stone stabilization, only where ordered by the Engineer, will be made in accord with the unit price bid for the item under "Extra Work," measured before placing and shall include the removal and disposal of unsuitable subgrade materials

3.07 UTILITY BEDDING

- A. Bedding type and depth shall be as specified in other sections for the utility type being constructed.
- B. Installation:
1. Place on dry subgrade
 2. Minimum thickness: 6 inches
 3. Compact to 95% modified Proctor
 4. Grade for proper pipe slope
- C. Pipe Installation:
1. Place pipe on prepared bedding

2. Support full length of pipe
3. Install per utility specifications

3.08 BACKFILLING

A. Initial Backfill:

1. Place in 6-inch lifts
2. Hand tamp around pipe
3. Minimum cover: 12 inches above pipe
4. Compact to 95% modified Proctor

B. Final Backfill:

1. Place in 12-inch lifts
2. Moisture condition as needed
3. Compact to specified density
4. Match existing grade

C. Compaction Requirements:

1. Under pavements: 95% modified Proctor
2. Landscaped areas: 90% modified Proctor
3. Structural areas: 98% modified Proctor

3.09 REMOVING PAVEMENT

A. The Contractor shall remove pavement as necessary for trench construction.

B. Marking and Cutting:

1. Marking: Before removing any pavement, the pavement shall be marked for cuts neatly paralleling pipe lines and existing street lines.
2. Cutting: Power saws shall be used to cut all types of pavement along marked lines. The pavement shall be sawed to a depth of at least 2" or deeper if the Engineer so directs. "Sawing" is not a separate pay item and the cost thereof shall be included in the overall bid submitted.

C. Machine Pulling: No pavement shall be machine pulled until completely separated along the marked cuts.

D. Damage to Adjacent Pavement: The pavement adjacent to trenches must not be disturbed or damaged. If the adjacent pavement is disturbed or damaged due to any cause, such as caving ditch banks, indiscriminate use of construction machinery, etc., the Contractor shall remove the damaged pavement and shall replace at his own expense.

- E. Stone or Concrete Curb: The Contractor shall remove and replace or tunnel under any stone or concrete curb encountered. No additional payment will be made for removing, replacing, or tunneling under said curb.
- F. Tunnelling: Tunneling will be permitted under existing sidewalks, curbs and gutters, but not under pavement.

3.10 DISPOSAL OF MATERIAL

- A. Excess spoil material shall be disposed of offsite at the Contractor's expense unless a designated spoil area is noted on the Drawings.
- B. All waste materials shall be disposed of in accordance with applicable state and local regulations.

3.11 FIELD QUALITY CONTROL

- A. Testing:
 - 1. One test per 100 linear feet per lift
 - 2. One test per structure
 - 3. Additional tests as directed
- B. Test Methods:
 - 1. In-place density: ASTM D6938
 - 2. Moisture content: ASTM D6938
 - 3. Compaction: ASTM D1557
- C. Acceptance Criteria:
 - 1. Density within 2% of specification
 - 2. Moisture within 2% of optimum
 - 3. No visible settlement

3.12 CONSTRUCTION ALONG HIGHWAYS, STREETS, AND ROADWAYS

- A. General:
 - 1. Where required, excavations along highways, streets, and roadways in accordance with the applicable regulations of the State Department of Transportation, and the Owner, with reference to construction operations, safety traffic control, road maintenance, and repair.
- B. Protection of Traffic:
 - 1. The Contractor shall provide suitable signs, barricades, and lights for protection of traffic, in locations where traffic may be endangered by construction operations. All highway signs removed due to construction shall be replaced as soon as the conditions, which necessitated such removal, have been cleared. No highways, streets, or roadways shall be closed without

first obtaining permission from the proper authorities. Before any roadway is blocked, the Contractor shall notify the Owner's Superintendent of Utilities.

C. Construction:

1. Stripping: Where the pipe lines or other utilities are laid along road shoulders, all sod, topsoil and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.
2. Trenching, Laying, and Backfilling: The Contractor shall open trenches, install pipe line, and backfill. The trench shall not be opened any further ahead of pipe laying operations than is necessary for proper laying operations, and trenches shall be progressively backfilled and consolidated, and excess material removed immediately behind the laying operations.
3. Shaping: The Contractor, immediately after completing backfilling operations shall reshape any damaged cut and fill slopes, side ditches and ditch lines, and shall replace topsoil, sod and any other materials removed from shoulders, in accordance with the requirements of, and to the full and complete satisfaction of the State Department of Transportation and the Owner. The Contractor, when installing pipe lines and appurtenances, will be required to provide sufficient personnel and equipment so-as-to simultaneously carry out all of the above operations.

D. Encroachment Permits:

1. Where required for construction within rights-of-way, permits for such work will be obtained by the Owner.
2. All cost for labor, materials, and supervisory personnel furnished by the Department of Transportation in connection with the work, if any, shall be at the expense of the Contractor.
3. The Contractor shall be responsible for fully informing himself with regard to all Department of Transportation regulations and conditions relating to pipe line installation

3.13 SAFETY

- A. Trenches must be excavated in accordance with OSHA requirements to allow for safe installation and inspection. Sidewalls shall be stabilized by sloping, shoring, or shielding systems where required.
- B. An OSHA certified "Competent Person" must be present during all excavation and trenching activities.
- C. Ladders or ramps must be provided for inspection access per OSHA requirements.
- D. Excavated materials shall be placed in a manner that will not obstruct work nor endanger the workers, obstruct roads or walkways.

3.14 PROTECTION

- A. Excavated material shall not be placed along highways, streets, and roadways in such a manner as to obstruct traffic. No scattered excavated material shall be allowed to remain on the pavement and all such material shall be kept swept away.

- B. Construct berms or swales as required to prevent the entry off excess runoff into trenches.
- C. Grade trench bottoms to prevent ponding.
- D. Contractor shall utilize approved traffic control methods where required along public rights-of-way.

3.15 CLEAN UP

- A. The Contractor shall furnish a road grader, which shall be available for use at all times, for maintaining highways, streets, and roadways upon which work is being performed. All such highways, streets, and roadways shall be maintained in suitable condition for movement of traffic until completion and final acceptance of the work.
- B. Repair:
 - 1. Correct settlement immediately
 - 2. Repair surface damage
 - 3. Maintain until final acceptance

END OF SECTION

SECTION 31 23 630

ROCK BLASTING

PART 1 - GENERAL

1.01 SUMMARY

A. General:

1. Rock blasting shall be allowed only with prior approval from the Engineer.

B. Section Includes:

1. Controlled blasting of rock for excavations of utility trenches and structures, including drilling, explosive placement, detonation, and removal of blasted rock.
2. Related activities: pre-blast surveys, vibration monitoring, and safety measures.

C. Related Sections:

1. Section 21 23 00 – Excavation and Backfill for Structures
2. Section 31 23 33 – Trenching and Backfilling (for utility trench prep and backfill).
3. Section 31 20 00 – Earth Moving (general excavation coordination).
4. Section 33 05 05 – Buried Pipe Installation (pipe materials and installation).
- 5.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D5878 - Standard Guides for Using Rock Mass Classification Systems for Engineering Purposes.

B. Federal Standards:

1. OSHA 29 CFR 1926 Subpart U – Blasting and the Use of Explosives.
2. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) 27 CFR Part 555 – Commerce in Explosives.

C. Other Standards:

1. International Society of Explosives Engineers (ISEE) Blaster's Handbook (latest edition).
2. National Fire Protection Association (NFPA) 495 – Explosive Materials Code

1.03 SUBMITTALS

- ###### **A. Blasting Plan: Submit detailed plan 14 days prior to blasting, including:**

1. Drilling patterns, explosive types, charge weights, and detonation sequence.
2. Safety procedures, exclusion zones, and notification schedule.
3. Vibration and airblast limits with monitoring locations.
4. Qualifications: Submit blaster's license, certifications, and proof of 5 years' experience in utility blasting.
5. Pre-Blast Survey: Submit report documenting condition of nearby structures within 500 feet of blast site.
6. Monitoring Records: Submit daily seismograph and airblast data post-blast.
7. Permits: Submit copies of federal, state, and local blasting permits

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Blasting Contractor: Licensed by State Fire Marshal, with 5 years' experience in controlled blasting for utilities.
2. Blaster-in-Charge: Certified by OSHA 1926.901 and ISEE, with current explosives handling license.

B. Regulatory Requirements:

1. Comply with OSHA 29 CFR 1926 Subpart U, ATF 27 CFR Part 555, and NFPA 495.
2. Obtain and adhere to all federal, state, and local permits for explosive storage, transport, and use.
3. Comply with Georgia Fire Safety Commissioner's Rules on Blasting (120-3-10)

C. Pre-Blast Conference:

1. Blasting contractor shall conduct meeting with Owner, Engineer, General Contractor, and utility representatives to review plan and safety protocols.

1.05 DELIVERY AND STORAGE

A. Explosives:

1. Deliver in original containers, labeled per ATF requirements.
2. Store in secure, ATF-compliant magazines, separated from ignition sources, per NFPA 495
3. Transport and handle explosives only by licensed personnel.
4. Prohibit smoking or open flames within 100 feet of storage area.

PART 2 - PRODUCTS

2.01 EXPLOSIVES

A. Type:

1. Commercial explosives suitable for controlled rock fragmentation Selection shall be based on rock type per ASTM D5878 classification.

B. Detonators: Electric or non-electric (e.g., shock tube), delay type, compatible with explosives.

C. Blasting Mats: Heavy-duty rubber or steel cable mats, sufficient to contain flyrock.

2.02 DRILLING EQUIPMENT:

A. Drills: Pneumatic or hydraulic rock drills, capable of 1.5- to 3-inch diameter holes, depth to exceed trench bottom by 6 inches.

B. Accessories: Steel bits, rods, and compressors suited to site geology.

2.03 MONITORING EQUIPMENT

A. Seismographs: Portable, recording peak particle velocity (PPV) and frequency, calibrated per ISEE standards.

B. Airblast Monitors: Capable of measuring overpressure in decibels (dB), placed per blasting plan.

PART 3 - EXECUTION

3.01 PREPARATION

A. Pre-Blast Survey:

1. Document condition of structures, utilities, and wells within 500 feet of blast site via photos and written report.
2. Notify property owners within 1,000 feet at least 48 hours prior.

B. Site Assessment:

1. Evaluate rock mass per ASTM D5878 (e.g., hardness, fracturing) to determine blast design.
2. Verify existing utility locations via locates (e.g., "Call Before You Dig").

C. Permits: Secure blasting permits from local authorities; post notices as required.

3.02 BLASTING OPERATIONS

A. Drilling:

1. Drill holes in pattern per blasting plan (e.g., 2- to 4-foot spacing, 1- to 2-foot burden), angled if needed for trench alignment.
2. Depth: 6 inches below required trench bottom or as specified for pipe bedding.

B. Explosive Placement:

1. Load charges per plan, using stemming (e.g., crushed stone) to fill upper 1/3 of holes.
 2. Limit charge weight to control vibration (e.g., <2.0 in/sec PPV at nearest structure).
- C. Detonation:
1. Use delay detonators to minimize vibration and fragment rock (e.g., 25 ms delays).
 2. Cover blast area with mats or soil to contain flyrock.
 3. Sound audible warning (e.g., 3 long blasts) 5 minutes prior; clear exclusion zone (e.g., 500 feet).
- D. Safety:
1. Restrict access per OSHA 1926.910; post sentries at perimeter.
 2. Suspend blasting in adverse weather (e.g., lightning within 10 miles)
- 3.03 ROCK REMOVAL
- A. Excavation
1. Remove blasted rock to trench lines or structure grades as required on the drawings or otherwise specified.
 2. Break oversized fragments (>6 inches) with hydraulic breaker or secondary blasting.
- B. Disposal: Haul excess rock off-site or stockpile per contract documents.
- 3.04 PROTECTION:
1. Protect existing pipes, cables, or structures within 50 feet with reduced charges or pre-splitting.
 2. Public Safety: Maintain exclusion zone until “all clear” signal (e.g., 1 long blast) post-detonation.
- 3.05 CLEANUP AND RESTORATION
1. Remove debris from blast site.
 2. Utilities or structures damaged during the blasting operations shall be repaired at the Contractor’s expense.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENT CONTROL AND STORM WATER MONITORING

PART 1 - GENERAL

1.01 DESCRIPTION:

1.02 SUMMARY

A. Section includes:

1. Temporary and permanent erosion and sediment control measures to prevent soil loss and protect water quality during and after construction.
2. Compliance with the Georgia Erosion and Sedimentation Act of 1975 (O.C.G.A. § 12-7-1 et seq.) and the Georgia EPD National Pollutant Discharge Elimination System (NPDES) General Permit for Construction Activities (GAR100001, GAR100002, or GAR100003 as applicable)
3. Installation, maintenance, and removal of erosion and sediment control devices.
4. Stormwater monitoring and record keeping

1.03 RELATED DOCUMENTS

A. Related Specifications

1. Section 31 10 00 – Site Clearing
2. Section 31 20 00 – Earth Moving
3. Section 31 23 00 – Excavation and Fill for Structures
4. Section 31 23 33 - Trenching and Backfilling
5. Section 32 92 00 - Turf and Grasses

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
3. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes
4. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

5. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
 - B. Georgia Soil and Water Conservation Commission (GSWCC) –
 1. Manual for Erosion and Sediment Control in Georgia (latest edition)
 - C. Georgia Department of Natural Resources, Environmental Protection Division (EPD)
 1. NPDES General Permit GAR100001 for Stormwater Discharges Associated with Construction Activity for Stand Alone Construction Projects
 2. NPDES General Permit GAR100002 for Stormwater Discharges Associated with Construction Activity for Infrastructure Construction Projects
 3. NPDES General Permit GAR100003 for Stormwater Discharges Associated with Construction Activity for Common Development Construction Projects
 - D. Georgia Department of Transportation
 1. Qualified Product List (QPL)
- 1.05 DEFINITIONS AND ABBREVIATIONS
- A. EPD : Georgia Department of Natural Resources, Environmental Protection Division
 - B. BMP: Best Management Practice
 - C. NPDES: National Pollution Discharge Elimination System
- 1.06 SUBMITTALS
- A. Product Data:
 1. Silt Fence Systems
 2. Geotextile Fabrics
 - B. Sampling Reports and Inspection Reports:
 1. Submit all logs, inspection reports, and sample reports with each pay application.
 - C. Storm Water Permitting:
 1. Contractor shall submit a copy of the Notice of Intent (NOI) and GEOS submittal receipt a minimum of 14 days prior to commencement of construction activities.
 2. Contractor shall submit a copy of the Notice of Termination (NOT) after final stabilization is achieved.
- 1.07 QUALITY ASSURANCE
- A. Contractor shall employ competent personnel with a minimum of Level IA Certification from the Georgia Soil and Water Conservation Commission to oversee construction, inspection, and maintenance of the Erosion and Sediment Control and Stormwater Monitoring Program.

PART 2 - PRODUCTS

2.01 GENERAL:

- A. All materials shall be first-class quality to withstand a 25-year storm event.

2.02 SILT FENCE

A. Types:

1. Sensitive “S”: Sediment barriers used in sensitive areas that need additional protection such as state waters, wetlands, or other areas designated by the Engineer. Type “S” sediment barriers shall have a P factor no greater than 0.030
2. Non-Sensitive “NS”: Sediment barriers used in non-sensitive areas. Type “NS” sediment barriers shall have a P factor no greater than 0.045.

B. Fabric: Silt fence fabric shall have the following characteristics:

1. Has strong rot-proof synthetic fibers formed into either a woven or non-woven fabric.
2. Has no treatment or coating that might significantly alter its physical properties after installation.
3. Contains stabilizers and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat.
4. Makes a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other under normal handling, installation, and service conditions.
5. Has finished fabric edges to prevent the outer yarn from pulling away from the fabric.
6. Has no defects or flaws that would significantly affect its physical and/or filtering properties.
7. Meets the following physical and dimensional requirements

Fence Type	NS Non- Sensitive	S Sensitive	Test Method
Minimum Tensile Strength (lbs)	Warp: 120 Fill: 100	Warp: 120 Fill: 100	ASTM D4632
Elongation (% Max.)	40	40	ASTM D4632
Apparent opening size (max. sieve size)	No. 30	No. 30	ASTM D4751
Flow Rate (gal/min/sft)	25	70	GDT 87
Ultraviolet Stability	80	80	ASTM D4751
Bursting Strength (psi)	175	175	ASTM D3786
Minimum Fabric Width (in)	36		

8. The fabric may be manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

9. The fabric shall have the manufacturer's mark, either with an approved color mark yarn in the fabric or the manufacturer's name and product trade name labeled on the fabric at a minimum of 100 ft interval.

C. Post:

1. Posts shall be a minimum of 4' long and either hardwood or steel may be used.
 - a. Hardwood Posts shall be 1.5" × 1.5" with a cross-section of 2.25-square inch.
 - b. Steel posts shall be "U", "T" or "C" shaped with a minimum weight of 1.15-pounds per foot with props for fastening the fence.
2. Maximum post spacing:
 - a. Type "NS" sediment barriers: 6' max. post spacing.
 - b. Type "S" sediment barriers : 4' max. post spacing.
3. Silt Fabric Fencing for type "S" silt fence.
 - a. Wire fence fabric shall be minimum 32 in high with at least 6 horizontal wires.
 - b. Vertical wires shall have a maximum spacing of 12 in.
 - c. Top and bottom wires shall be minimum 10 gauge and all other wires shall be a minimum 12-1/2 gauge.

2.03 CHECK DAMS

- A. Provide stone or haybale check dams where shown on the drawings in accordance with Manual for Erosion and Sediment Control in Georgia, latest edition. For stone check dams, the drainage area shall not exceed two acres. For hay bales, the drainage area shall not exceed one acre.
 1. Stone check dams should be graded sizes 2" to 10".
 2. Haybales shall be bound with wire or nylon string.

2.04 RIPRAP:

- A. Provide riprap where shown on the drawings in accordance with Manual for Erosion and Sediment Control in Georgia, latest edition.
 1. Riprap shall consist of stone or bagged sand-cement to a thickness of approximately 12".
 2. Stone shall be hard quarry or fieldstone of such quality that it will not disintegrate on exposure to water or weathering. Stone shall range in weight from a minimum of 25-pounds to a maximum of 150 pounds with at least 75% of the pieces weighing more than 50-pounds.
 3. Bagged sand-cement riprap shall consist of 1 part cement and 5 parts of sand in clean cloth bags approximately one cubic foot in size. Sand and cement shall be as specified for concrete work herein.

2.05 SLOPE STABILIZATION BLANKETS:

- A. Provide slope stabilization blankets on slopes greater than 3:1 or where otherwise noted on the drawings.
- B. Fiberglass Blanket:
 - 1. The fiberglass blanket shall be machine produced consisting of a uniform layer of continuous, randomly-oriented glass fiber strands. The blanket shall be at least 48" wide and weighing a minimum of 0.2 pounds per square yard when used on slopes and 0.4 pounds per square yard when in waterways.
 - 2. Staples for securing the blanket shall be made from cold drawn wire not less than 6" lengths of 14-gauge, to form a "U" of 1" in width. Longer staples may be required for loose soil.
- C. Straw Blanket
 - 1. The straw blanket shall be a machine-produced blanket of clean, weed-free straw from agricultural crops with consistent thickness and the straw evenly distributed over the entire area of
 - 2. The top of each blanket shall be covered with a photodegradable plastic mesh having a maximum mesh size of 5/16" × 5/16" which is sewn to the straw using biodegradable thread. The blanket shall be at least 48" wide with a minimum thickness of 3/8" and a minimum dry weight of 0.5-pounds per square yard.
 - a. Blankets within waterways shall have the photodegradable plastic mesh on the top and bottom.
- D. Excelsior Blanket:
 - 1. Excelsior Blanket shall be a machine produced mat of curled wood excelsior of which 80% has 6" or longer fiber length with consistent thickness and the fiber evenly distributed over the entire area of the blanket. The blanket shall be smolder resistant. The top of the blanket shall be clearly labeled.
 - 2. The top of each blanket shall be covered with a photodegradable plastic mesh having a maximum mesh size of 1½"× 3". The blanket shall be at least 48" wide with a minimum thickness of ¼" and a minimum dry weight of 0.8-pounds per square yard.
 - a. Blankets within waterways shall have the photodegradable plastic mesh on the top and bottom.

2.06 GRASSING

- A. Refer to Specification Section 32 92 00 Turf and Grasses

PART 3 - EXECUTION

3.01 PREPARATION

3.02 SOIL EROSION AND SEDIMENT CONTROL PROGRAM:

- A. Siltation and soil erosion shall be prevented by the installation of erosion control measures and practices prior to or concurrent with land-disturbing activities. The Contractor shall utilize silt fence, hay bales, mulch, grass, slope drains and other erosion control devices or machines as necessary. All soil erosion and sedimentation control measures must be installed prior to initiation of construction activity. Siltation and erosion control shall be in compliance with the "Georgia Erosion and Sedimentation Act of 1975" as amended to date and these Specifications. Erosion, sedimentation and pollution control may include temporary construction work outside the right of way where necessary as a result of construction operations, such as haul roads and equipment storage sites. Any violations of the Act shall be subject to those penalties and fines as defined by the Act
1. Erosion Control: Vegetation and mulch will be applied to applicable areas immediately after grading is completed. Best management practices (BMPs) will be employed to prevent erosion in areas of bare soils and concentrated water flows. Diversions and dikes will be installed to divert sediment-laden runoff into the sediment barriers and to protect cut and fill slopes from erosive water flows.
 2. Limit of Progress: The Engineer will limit the area of excavation commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding and other such pollution control measures current in accordance with an accepted schedule. Should seasonal limitations make such coordination unrealistic, special erosion control measures shall be taken immediately to the extent feasible and justified. Excavation shall not exceed 100' in advance of pipe laying.
 3. Construction in Rivers, Streams and Impoundments: Unless otherwise approved in writing by the Engineer, construction operations in rivers, streams and impoundments shall be restricted to those areas which must be entered for the construction of temporary or permanent structures. As soon as conditions permit, rivers, streams and impoundments shall be promptly cleared of all false work, piling which are to be removed, debris, and other obstructions placed therein or caused by the construction operations. Frequent fording of live streams with construction equipment will not be permitted; therefore, temporary bridges or other structures shall be used wherever an appreciable number of stream crossings are necessary. Unless otherwise approved in writing by the Engineer, mechanized equipment shall not be operated in live streams except as may be required to construct channel changes and temporary or permanent structures, and to remove temporary structures.
 4. Temporary Erosion Control: Temporary erosion control shall consist of planting temporary grass of a quick growing species such as millet, rye grass or cereal grasses suitable to the area. The Contractor shall use all means necessary to control dust on and near the work site and all offsite borrow areas. The Contractor should thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors and concurrent performance of work on the site. Where the location of temporary erosion control structures are not indicated on the Drawings, the following guidelines shall be used: Install sedimentation structures at the toe of all disturbed earth slopes, around all drainage structure inlets, across constructed drainage ways at approximately 150' centers and at the tops of slopes and terraced slopes as indicated on the details. Siltation fences or hay bales only shall be used across constructed drainage ways. Hay bales only shall be used at drainage structure inlets. Perimeter barriers may be any of the types detailed. All areas left disturbed for a period greater than 14 days shall be stabilized with temporary seeding or straw mulch.

3.03 SILT FENCE

A. Installation

1. Silt fence, of the type noted, shall be installed at locations shown on the drawings or otherwise required to prevent the escape of sediment from the project site.
2. Post installation shall start at the center of the low point (if applicable) with remaining posts spaced a maximum of 6' apart from Type "NS" fence and 4' apart for Type "S" fence. Post shall be driven in a minimum of 18".
3. Fabric shall be secured to post with nails, staples, wire or string. Toe of fabric shall be buried 6" in the soil with 2" turned back upstream. If fence is erected in sections, a minimum of 18" overlap will be required.

B. Maintenance:

1. Inspect weekly and within 24 hours after a rainfall event of 0.5 inches or greater.
2. Remove sediment from behind silt fences when it reaches 1/3 of fence height.
3. Repair or replace damaged measures within 48 hours of identification.

C. Removal

1. Remove only after permanent stabilization is achieved and approved by the Engineer or Local Authority.

3.04 CHECK DAMS

A. Installation:

1. Install per the Manual for Erosion and Sediment Control in Georgia.
2. Check dam must provide complete coverage over the entire width of the ditch or swale.
3. Stone Check Dams
 - a. The center of the check dam must be at least 9" lower than the ends and 2' tall maximum with 2:1 side slopes.
 - b. A geotextile should be used as a separator between the stone and the soil base.
4. Haybales should be staked with 2 × 2 wood post or No. 4 steel rebar and embedded a minimum of 4".

B. Maintenance:

1. Sediment shall be removed when it reaches a depth of one-half the original dam height or before.

C. Removal

1. If the area is to be mowed, check dams shall be removed once final stabilization has occurred. Otherwise check dams may remain in place permanently unless noted otherwise on the drawings.

2. After removal, the area beneath the dam shall be seeded and mulched immediately.

3.05 SLOPE STABILIZATION

- A. Sedimentation shall be controlled by the use of hay mulch on all slopes.
- B. On slopes greater than 3:1, the Contractor shall install blankets.
 1. Prior to placing the blanket, the grassing shall have been completed and the area left in a smooth, uniform condition, free from stones, lumps, roots, and other material which would prevent the blanket from making snug contact with the underlying soil.
 2. Securing and Stapling Fiberglass Blankets
 - a. Staples for securing the blanket shall be made from cold drawn wire not less than 6" lengths of 14-gauge, to form a "U" of 1" in width. Longer staples may be required for loose soil. All staples shall be driven flush with the ground.
 - b. Each strip of the blanket shall be held firmly in place by means of three rows of staples; one row along each edge and one row along the middle. The staples shall be spaced no more than 3' apart in each row with the staples in the middle row spaced alternately with those at the edges. The edge staples shall be placed in the 2" overlap. At the end of each blanket, staples shall be placed in a row with spacing of approximately 12".
 - c. An anchor slot or trench, 9" in depth, shall be dug across the upgrade end of the site. The first 12" of the blanket shall be placed in the trench and the backfill tamped solidly in place. Adjacent strip ends shall overlap 2" and adjoining ends shall overlap 6" with the upstream section on top.
 3. Securing and Stapling Straw or Excelsior Blankets
 - a. Staples shall be driven vertically into the ground to anchor the plastic mesh.
 - b. Staples shall be spaced approximately 2-yards apart on each side of the blanket and one row in the center alternately spaced between each side staple. Where blankets are laid side to side, the staples shall be placed with half of the staple anchoring mesh from each blanket. At the beginning of a blanket, staples shall be placed in a row with spacing of approximately 12".
 - c. In waterways, there shall be no longitudinal seams unless overlapped at least 6" with the upgrade section on top. The first 12" of the first row of blankets shall be placed in a 6" deep anchor slot stapled in the bottom, and the slot shall be backfilled and solidly tamped.

3.06 MAINTENANCE PROGRAM

- A. Best management practices will be inspected daily. Any damages will be repaired by the end of the day.
- B. Cleanout of sediment control structures will be accomplished in accordance with the publication entitled "Manual for Erosion and Sediment Control in Georgia," latest edition and sediment disposal accomplished by spreading on the site.

- C. Sediment basins and barriers will remain in place until disturbed areas are stabilized. The sediment control barriers will then be removed and the areas by these structures grassed.
- D. In case of failure on the part of the Contractor to adequately control erosion, pollution, and / or siltation, the Owner reserves the right to employ outside assistance or to use his own forces to provide the necessary corrective measures. Such incurred direct costs plus Project Engineering costs will be charged to the Contractor and appropriate deductions made from the Contractor's monthly progress estimate.

3.07 FINAL STABILIZATION

- A. When monitoring is required, stabilized means at least 70% of the soil surface is uniformly covered in permanent vegetation unlike the NPDES Stormwater Discharges Associated with Construction Activities, General Permit (GAR 100001, 100002, 100003), which includes installation of equivalent permanent stabilization measures (such as the use of riprap, gabions, permanent mulches or geotextiles).
- B. Permanent vegetation consists of planted trees, shrubs, perennial vines; a crop of perennial vegetation appropriate for the season and region; or a crop of annual vegetation and a seeding of target crop perennials appropriate for the region such that within the growing season a 70% coverage by the perennial crop is achieved. For linear construction projects on agricultural or silvicultural lands, stabilized means stabilizing it for its agricultural or silvicultural use.
- C. Final acceptance for payment is defined as a full cover, over the seeded area of live and growing grass, when at least 98% of the total areas has no bare spots exceeding 1-square foot, and the ground surface is fully stabilized against erosion.
- D. Final acceptance must be granted by the Engineer and/or Local Authority.

3.08 STORMWATER MONITORING:

- A. Under the requirements of the NPDES Stormwater Discharges Associated with Construction Activities, General Permits (GAR 100001, 100002, 100003) for projects greater than 1.0 acres, the Contractor is required to act as a Primary Permittee. The Contractor shall submit the Notice of Intent (NOI) to the Georgia Environmental Protection Division (EPD) 14 days prior to the commencement of Construction activities using the Georgia EPD Online System (GEOS) for Permitting, Compliance and Facility Information. The General Contractor is responsible for GEOS system registration.
- B. Prior to construction, a copy of the NOI shall be provided to the Engineer. The Contractor shall pay all Land Disturbing / NOI fees to the Georgia EPD and / or the Local Issuing Authority (LIA).
- C. Reporting
 - 1. Contractor shall submit "Monthly Records" by the 15th of each month following a sampling event utilizing GEOS. Any questions should be directed to the Georgia EPD and/or the LIA. In order to submit the Notice of Termination (NOT), the Contractor must meet all requirements of Final Stabilization, receive approval of Engineer, and meet all sampling requirements. A copy of the NOT shall be provided to the Engineer along with the final pay request.
- D. Sampling Guidelines:

1. Rainfall must be recorded daily (once every 24 hours) at the site.
2. Samples must be collected as ‘grab samples’ and analyzed in accordance with 40 CFR Part 136, NPDES Stormwater Sampling Guidance Document EPA 833-B-92-001, and any guidance prepared by the Georgia EPD. Below is a list of approved test procedures for Turbidity included in 40 CFR Part 136:
 - a. Standard Methods, 18th Edition 2130B
 - b. ASTM D1889-88(A)
 - c. USGS I-3860-85
3. Sample containers should be labeled prior to sample collection.
4. Samples should be well mixed before transferring to a secondary container.
5. Collection containers should be large mouth, well-cleaned and rinsed glass or plastic.
6. Manual or automatic sampling may be utilized. Sample analysis should be done immediately but never longer than 48 hours after collection. Cooling of samples is not required.
7. Any sampling and analysis done beyond the minimum frequency required by permit must be reported to the Georgia EPD in same format as monitoring report.
8. Sampling shall be representative of the monitored activity and the water quality of the receiving water and/or stormwater outfall. Both upstream and downstream sampling shall be performed in accordance with these specifications and as may be required by the General Permits (GAR 100001, 100002, 100003) at each sample site location as indicated on Drawings. Monitoring multiple sample sites concurrently will only be required if multiple sites are disturbed and have not been stabilized as defined in the “Final Stabilization” section of these Specifications.
9. Upstream sample must be taken immediately upstream of first stormwater discharge from the permitted activity but downstream of any other stormwater discharges not associated with the permitted activity.
10. Downstream sample must be taken immediately downstream of last stormwater discharge from the permitted activity but upstream of any other stormwater discharge not associated with the permitted activity.
11. Several samples from across the receiving water may need to be taken and the arithmetic mean of the turbidity of the samples used to derive turbidity value, where appropriate.
12. Ideally, samples should be taken from the horizontal and vertical center of the stream or outfall channel being sampled.
13. Avoid stirring bottom sediments during sampling.
14. When sampling, hold sampling container with mouth facing upstream.
15. Keep samples free from floating debris.

E. Sampling Points:

1. For Non-Linear Construction: The Contractor must sample all receiving water(s), or all outfall(s), or a combination of receiving water(s) and outfall(s).
2. For Infrastructure Construction: The Contractor must sample all perennial and intermittent streams and other water bodies shown on the USGS topographic map and all other field verified perennial and intermittent streams and other water bodies. However, the Contractor may sample the representative perennial and intermittent streams, other water bodies or outfalls, or a combination thereof if approved by the Engineer who prepared the Plan and the Engineer certifies that an increase in the turbidity of a specific identified receiving water to be sampled will be representative of the increase in the turbidity of a specific identified unsampled receiving water. If this option is selected, the Contractor shall furnish a written rationale and detailed analysis justifying representative sampling.
3. The Contractor does not have to sample sheetflow that flows onto undisturbed natural areas or areas stabilized by the project.
4. If at any time during the life of the project a selected receiving water no longer represents another receiving water, then the Permittee shall sample the latter receiving water until an alternate representative receiving water is selected.
5. If at any time during the life of the project, receiving water is determined not to be represented as certified in the Plan, the Permittee shall sample that receiving water until a Notice of Termination (NOT) is submitted or until the applicable phase is stabilized.
6. Monitoring obligations shall cease for any phase of the project that has been stabilized as defined in the "Final Stabilization" section of these specifications.

F. Sampling Frequency:

1. Contractor must sample at least once for each rainfall event described below. Samples must be taken within 45 minutes of:
2. The accumulation of the minimum amount of rainfall, if the storm discharge to a monitored receiving water or from a monitored outfall has begun at or prior to the accumulation, or
3. The beginning of any stormwater discharge to a monitored receiving water or from a monitored outfall, if the discharge begins after the accumulation of the minimum amount of rainfall
4. Where manual and automatic sampling are impossible or are beyond the Permittee's control, the Permittee shall take samples as soon as possible, but in no case more than 12 hours after the beginning of the stormwater discharge.

G. Qualifying Rainfall Events:

1. First rainfall event greater than or equal to ½" during normal business hours that occurs after all clearing and grubbing operations have been completed with implementation of BMP's. (Monday thru Friday, 8:00 A.M. to 5:00 P.M. and Saturday 8:00 A.M. to 5:00 P.M. when construction activity is in progress.)
2. First rainfall event greater than or equal to ½" during normal business hours occurring either 90 days after the first sampling event or after all mass grading operations have been completed, whichever comes first.

3. In addition to the above events, where BMPs have not been properly designed, installed, or maintained, corrective action shall be defined and implemented within 2 business days and turbidity samples shall be taken from discharges for each subsequent rainfall event greater than or equal to ½" during normal business hours until the selected turbidity standard is attained, or until post-storm event inspections determine BMPs have been properly designed, installed, and maintained.
4. Sampling may occur from any rainfall event that reaches or exceeds ½" and allows for monitoring at any time of the day or week.

H. Reporting Requirements:

1. The Contractor is required to submit a summary of the monitoring results to the Georgia EPD by the 15th of the month using GEOS and to the local issuing authority in jurisdictions authorized to issue a Land Disturbance Activity permit. For a monitoring period during which no qualifying rainfall events occur, a monitoring report must be submitted stating such. Monitoring periods are calendar months. Monitoring reports must be submitted to the Georgia EPD until the NOT is submitted. Enclosed are suggested forms for your use including a monthly monitoring summary report, a daily sampling form and a rainfall data log form. The Contractor may use other report forms; however, the format of all forms should be as prescribed by the Georgia EPD.
2. Upon written notification, the Georgia EPD may require the Contractor to submit the monitoring results on a more frequent basis.
3. Sampling and analysis of any stormwater discharge(s) or the receiving water(s) beyond the minimum frequency stated in Permit No. GAR 100001, 100002, 100003 must be reported in a similar manner to appropriate District Georgia EPD office.
4. The monitoring reports must be signed by an appropriate person as detailed in Part V.G Signatory Requirements in General Permit (GAR 100001, 100002, 100003).
5. As required by the General Permit (GAR 100001, 100002, 100003), the Contractor shall retain a copy of the Erosion, Sedimentation, and Pollution Control Plan at the construction site or be readily available at a designated alternate location from the date of project initiation to the date of final stabilization.
6. Copies of all Notices of Intent, Notices of Termination, reports, plans, monitoring reports, monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, Erosion, Sedimentation and Pollution Control Plans (ESPC), records of all data used to complete the Notice of Intent, and all other records required by General Permit (GAR 100001, 100002, 100003) shall be retained by the Permittee who either produced or used it for a period of at least three years from the date that the site is finally stabilized. These records must be maintained at the Contractor's primary place of business once the construction activity has ceased at the permitted site. This period may be extended by request of the Georgia EPD at any time upon written notification to the Permittee.

I. Inspection and Entry:

1. Inspections must be done by qualified personnel provided by the contractor, a primary Permittee. Qualification involves successfully completing an erosion and sediment control

short course eligible for continuing education units or an equivalent course approved by the Georgia EPD and the State Soil and Water Conservation Commission.

2. Inspections must be done at least once every 14 calendar days and within 24 hours of the end of a storm that is ½" or greater until a Notice of Termination is submitted on the following areas:
 - a. Disturbed areas that have not undergone final stabilization
 - b. Areas used for storage of materials that are exposed to precipitation that have not undergone final stabilization
 - c. Structural control measures to ensure they are operating correctly. Where discharge locations are accessible, they should be inspected to see if measures of control are effective.
3. Inspections must be done each day when any type of construction activity has taken place of the following areas:
 - a. Where petroleum products are stored, used, or handled for spills and leaks from vehicles and equipment
 - b. Locations where vehicles enter or exit the site for evidence of off-site sediment tracking, this inspection must be done until the Notice of Termination is submitted.
4. Inspections must be done at least once per month during the term of the permit the areas that have undergone final stabilization for evidence of or the potential for pollutants entering the drainage system and the receiving water(s). Erosion and sediment control measures should be observed to ensure that they are operating correctly. Discharge points should be inspected to check effectiveness of control measures. As a result of inspection, the ESPC Plan should be revised no later than 7 days following the inspection to correct any problems.
5. A report documenting inspections should be kept on site until entire site or that portion of a project that has been phased has undergone final stabilization and an NOT submitted to the Georgia EPD. The report should contain the name of personnel inspecting, date of inspections, observations, and any corrective actions taken. Any incidents of non-compliance should be identified. If there are none, the report should certify that there were none.
6. The Permittee shall allow the Director or an authorized representative of EPA, State or local government or, in the case of construction site which discharges through a municipal separate storm sewer, an authorized representative of the municipal operator of the separate storm sewer receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:
 - a. Enter upon the primary Permittee's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of the permit;
 - b. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and
 - c. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment).

J. Violations:

1. Failure to properly design, install, or maintain best management practices constitutes a violation for each day on which such a failure occurs. A discharge of stormwater runoff from disturbed areas where best management practices have not been properly designed, installed, or maintained constitutes a separate violation for each day on which such discharge results in the turbidity of receiving water(s) being increased by more than 10 nephelometric turbidity units for water classified as trout streams or more than 25 nephelometric turbidity units for water supporting warm water fisheries. When the Contractor has elected to monitor outfall(s), the discharge of stormwater runoff from disturbed areas where best management practices have not been properly designed, installed, and maintained constitutes a separate violation for each day on which the turbidity of the discharge exceeds the nephelometric turbidity unit (NTU) value as determined by the property Owner's Engineer.

K. Payment:

1. Payment for implementation and maintenance of the Plan shall be in accordance with the unit prices as bid under the Erosion, Sedimentation, and Pollution Control Plan pay item. The Contractor shall be paid a unit price amount for establishing, constructing or putting into operation each monitoring site. A monitoring site indicated on the drawings and as described in these specifications shall include both an upstream and downstream sample point. This unit price amount should include all reports, rainfall measuring and inspection for each monitoring site. The Contractor will then be paid for each sampling event at each monitoring site. At each pay estimate for the project, the Contractor will be required to submit one (1) copy of all logs, reports, and sample data to justify payment. Final payment for this work cannot be issued until an NPDES Notice of Termination has been filed for all work and final sampling has been completed.

END OF SECTION

SECTION 31 31 00
SOIL TREATMENT

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK:

- A. Provide soil treatment for termite control as herein specified.
- B. The extent of work is shown and shall include, but not be limited to:
 - 1. The new cut areas within the exterior perimeter walls.
 - 2. Areas from the exterior of perimeter walls to a distance of five (5) feet beyond the building perimeter as directed.
 - 3. Conduct a job site meeting to determine limits of work.
- C. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 07 26 00 – Vapor Barrier.
 - 3. Section 07 92 00 – Joint Sealants.

1.03 SUBMITTALS:

- A. Product Data: Submit general information, MSDS and EPA-Registered Label for all products.
- B. Product Certificates: For termite control products, signed by product manufacturer.
- C. Qualification Data: For installer of termite control products.
- D. Soil treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following:
 - 1. Date and time of application.
 - 2. Moisture content of soil before application.
 - 3. Brand name and manufacturer of termiticide.
 - 4. Quality of undiluted termiticide used.
 - 5. Dilutions, methods, volumes, and rates of application used.
 - 6. Areas of application.

7. Water source for application.

1.04 QUALITY ASSURANCE:

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work, including preparation of substrate and application.
- B. Engage a professional pest control operator, licensed in accordance with regulations of governing authorities for application of soil treatment solution.
- C. Use only termiticides, which bear a federal registration number of the U.S. Environmental Protection Agency and are approved by local authorities having jurisdiction.

1.05 JOB CONDITIONS:

- A. Restrictions: Do not apply soil treatment solution until excavating, filling and grading operations are completed, except as otherwise required in construction operations.
 - 1. To ensure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather. Comply with handling and application instructions of the soil toxicant manufacturer.

1.06 SPECIFIC PRODUCT WARRANTY:

- A. Furnish written warranty certifying that applied soil poisoning treatment will prevent infestation of subterranean termites and that if subterranean termite activity is discovered during warranty period, Contractor will retreat soil and repair or replace damage caused by termite infestation.
 - 1. Provide warranty for a period of 5 years from date of treatment, executed by Applicator and Contractor.

1.07 NOTICES:

- A. Upon completion of the structure, a printed notice shall be posted inside the structure, stating:
 - 1. Termite protection has been provided by means of soil treatment with formulations, which shall be identified fully.
 - 2. Annual inspections shall be made to detect the presence of any subterranean termites which may have breached the chemical barrier.
 - 3. Date of the dates that soil treatment was applied.
 - 4. Full name and address of the pest control firm which rendered treatment.

PART 2 - PRODUCTS:

2.01 SOIL TREATMENT SOLUTION:

- A. Use an emulsible concentrate insecticide for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent. Provide a working solution of one of the following chemical elements:

1. Premise 75, Bayer.
 2. Demon TC, Syngenta.
 3. Termidor, Aventis.
- B. Dilute with water to concentration level recommended by manufacturer.
- C. Use only soil treatment solutions, which are not harmful to planting.
- D. Deliver toxicants to the job site in sealed containers bearing the manufacturer's warnings to be observed in handling and use. Label shall bear evidence of registration under the Federal Insecticide, Fungicide and Rodenticide Act.

PART 3 - EXECUTION:

3.01 INSPECTION:

- A. Examine the areas and conditions under which soil treatment for termite control is to be installed and notify in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an approved manner.

3.02 APPLICATION:

- A. Surface Preparation: Remove foreign matter, which could decrease effectiveness of treatment on areas to be treated. Loosen, rake and level soil to be treated, except previously compacted areas under slabs and foundations. Toxicants may be applied before placement of compacted fill under slabs, if recommended by toxicant manufacturer.
- B. Application:
1. Application rates – Apply soil treatment solution in accordance with the written recommendations of the toxicant manufacturer.
 2. Allow not less than 12 hours for drying after application before beginning concrete placement or other construction activities.
 3. Under slab-on-grade, treat soil before concrete slabs are placed.
 4. At expansion joints, control joints and areas where slabs will be penetrated.
- C. To ensure penetration, do not apply soil treatment to frozen or excessively wet soils or during inclement weather.
- D. Post signs in areas of application warning workers soil poisoning have been applied. Remove signs where areas are covered by other construction.
- E. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

3.03 RETREATMENT:

- A. All chemicals used in the re-treatment must be previously certified as to type of chemical and rate of concentration.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing, placing, and compacting aggregate base course for pavements and other surfaced areas.

1.02 RELATED DOCUMENTS

A. Related Specifications

1. Section 31 20 00 – Earth Moving
2. Section 31 23 00 – Excavation and Fill for Structures
3. Section 32 12 16 – Asphalt Paving

1.03 REFERENCES

A. Georgia Department of Transportation

1. GDOT Construction Manual
2. GDOT Standard Specifications Construction of Transportation Systems (Latest Edition)
3. GDOT Supplemental Specifications Modifying the Standard Specifications Construction of Transportation Systems
4. Qualified Product List (QPL)

B. American Society for Testing and Materials (ASTM)

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
3. STM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports

1.04 SUBMITTALS

A. Product Data:

1. Submit aggregate gradation, source, and GDOT approval certification

- B. Test Reports:
 - 1. Provide results of gradation (ASTM C136), Proctor density (ASTM D698), and quality tests (e.g., soundness, abrasion)
- 1.05 DELIVERY AND STORAGE
 - A. Protect stockpiles from contamination by soil, debris, or excessive moisture
- 1.06 QUALITY ASSURANCE
 - A. Installer Qualifications: Minimum 3 years' experience installing base courses.
 - B. Furnish each aggregate material from single source throughout the Work.
 - C. Standards: Comply with GDOT Standard Specifications for Construction of Transportation Systems (latest edition.
- 1.07 PROJECT CONDITIONS
 - A. Weather Limitations: Place graded aggregate materials only on dry, thawed subgrade or subbase.

PART 2 - PRODUCTS

- 2.01 AGGREGATE MATERIALS
 - A. In accordance with GDOT Standard Specifications, latest revision, Section 815
 - B. Minimum 8-inch thickness unless noted otherwise on the drawings.

PART 3 - EXECUTION

- 3.01 GENERAL:
 - A. Construction methods shall conform to the Georgia Department of Transportation Construction Manual and GDOT Section 310 – Graded Aggregate Construction.
- 3.02 PREPARATION
 - A. Verify gradients and elevations of subbase are correct.
 - B. Verify utilities under paving are installed with excavations and trenches backfilled and compacted.
 - C. Verify compacted subgrade is to specified density.
 - 1. Proof roll subbase with fully loaded, tandem-axled dump truck in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft subbase and replace with compacted fill.
- 3.03 GRADED AGGREGATE BASE
 - A. Place aggregate equal thickness layers to total compacted thickness as indicated on the drawings.
 - B. Maximum Layer Compacted Thickness: 8 inches

- C. Minimum Layer Compacted Thickness: 3 inches
 - D. Compaction: Roller compact aggregate to:
 - 1. Group I Aggregate: 98% maximum dry density as determined by ASTM D1557.
 - 2. Group II Aggregate: 100% maximum dry density as determined by ASTM D1557
 - E. Level and contour surfaces to elevations, profiles, and gradients indicated.
 - F. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
 - G. Maintain moisture content during placement of Aggregate Base Course materials to within 2% of optimum moisture content as determined by ASTM D1557.
 - H. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- 3.04 FIELD QUALITY CONTROL
- A. Testing and Tolerances:
 - 1. Compaction: Test every 1,000 square yards using nuclear gauge (ASTM D2922; meet specified compaction.
 - 2. Thickness: Verify with one core sample per 1,000 square yard; within ¼ inch of specified thickness.
 - 3. Smoothness: Check with 10-foot straightedge; maximum ¼ inch deviation in 10 feet.
 - 4. Elevation: Check with surveying equipment, within ½ inch of specified elevation.
 - B. Corrective Action:
 - 1. Remove and replace areas failing density, thickness, or smoothness requirements at no cost to Owner.
 - 2. Defective areas shall be reworked or replaced and retested until area meets specification.
- 3.05 PROTECTION
- A. Protect from heavy traffic
 - B. Repair or replace areas damaged by rain or traffic prior to paving.
- 3.06 CLEANUP
- 3.07 Remove excess aggregate, debris, and construction materials from site
- 3.08 ACCEPTANCE:
- A. Final payment is subject to the Engineers acceptance for specified tolerances and trafficability.

END OF SECTION

SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Hot-mix asphalt (HMA) paving for roadways, parking lots, and associated areas.
2. Tack coat application.

1.02 RELATED DOCUMENTS

A. Related Specifications

1. Section 31 20 00 – Earth Moving
2. Section 32 11 23 – Aggregate Base Courses

1.03 REFERENCES

A. Georgia Department of Transportation

1. GDOT Construction Manual
2. GDOT Standard Specifications Construction of Transportation Systems (Latest Edition)
3. GDOT Supplemental Specifications Modifying the Standard Specifications Construction of Transportation Systems
4. Qualified Product List (QPL)

1.04 SUBMITTALS

A. Product Data:

1. Submit asphalt mix design, including aggregate gradation, binder type, and performance grade (PG).

B. Certificates:

1. Provide GDOT-approved supplier certification for asphalt materials.

C. Delivery Tickets:

1. Submit delivery tickets for all materials delivered to the site at the end of each day during the progress of work.

1.05 DELIVERY AND STORAGE

- ###### **A. Deliver asphalt mix at specified temperatures and protect from segregation during transport.**

- B. Store aggregate materials in stockpiles to prevent contamination and excess moisture.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 5 years' experience installing asphalt paving.
- B. Standards: Comply with GDOT Standard Specifications for Construction of Transportation Systems (latest edition), Section 400 - Hot Mix Asphaltic Concrete.
- C. Testing Agency: Independent, certified to perform asphalt density and thickness tests per ASTM standards.

1.07 PROJECT CONDITIONS

- A. Weather Limitations: Install asphalt only when air temperature is above 40°F and rising, and subgrade is free of frost or standing water, per GDOT Section 400.
- B. Avoid paving during rain or when rain is forecast within 4 hours of placement.

PART 2 - PRODUCTS

2.01 AGGREGATE BASE COURSE

- A. Refer to Section 32 11 23:
- B. In accordance with GDOT Standard Specifications, latest revision, Section 815
- C. Minimum 8-inch thickness unless noted otherwise on the drawings.
- D. Compacted to 98% maximum density (ASTM D698).

2.02 BITUMINOUS PRIME

- A. In accordance with GDOT Standard Specifications, latest revision, Section 412

2.03 ASPHALTIC CONCRETE BASE COURSE (If noted on the drawings)

- A. In accordance with GDOT Standard Specifications, latest revision, Section 828
- B. 25 mm Superpave, including bituminous material and hydrated lime.

2.04 ASPHALTIC CONCRETE BINDER COURSE (If noted on the drawings)

- A. In accordance with GDOT Standard Specifications, latest revision, Section 828
- B. 19 mm Superpave, including bituminous material and hydrated lime.

2.05 BITUMINOUS TACK COAT

- A. In accordance with GDOT Standard Specifications, latest revision, Section 413

2.06 ASPHALTIC CONCRETE SURFACE COURSE

- A. In accordance with GDOT Standard Specifications, latest revision, Section 828

- B. 12.5 or 9.5 mm Superpave, including bituminous material and hydrated lime, as indicated on the drawings
- 2.07 PAINT TRAFFIC STRIPING (If noted on the drawings)
 - A. In accordance with GDOT Standard Specifications, latest revision, Section 652
- 2.08 THERMOPLASTIC TRAFFIC STRIPE (If noted on the drawings)
 - A. In accordance with GDOT Standard Specifications, latest revision, Section 653

PART 3 - EXECUTION

3.01 GENERAL:

- A. Construction methods shall conform to the Georgia Department of Transportation Construction Manual and GDOT Section 400 – Hot Mix Asphaltic Concrete Construction

3.02 PREPARATION

- A. Verify gradients and elevations of base are correct.
- B. Verify utilities under paving are installed with excavations and trenches backfilled and compacted.
- C. Verify compacted subgrade and base course are ready to support paving and imposed loads.
 - 1. Proof roll subbase with fully loaded, tandem-axled dump truck in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft subbase and replace with compacted fill.
- D. Verify manhole frames and inlets are installed in correct position and elevation.
- E. When required, mill the existing surface to the required depth and cross slope as shown in the Drawings.
- F. Where roadways are constructed on fill, the embankment shall be placed in layers not over six (6") inches deep as measured before compaction and be thoroughly rolled to a density of 98% of the Standard Proctor Dry Density with sheeps foot or pneumatic tired roller. The work shall be executed in a manner which will ensure that no places too steep to roll are left in the embankment. Portions inaccessible to the roller shall be rammed by hand. All materials shall be visibly damp. Water shall be applied as directed to obtain close adhesion between layers and all parts of the material.
 - 1. Sheep's foot roller shall be of self-cleaning type, have feet projecting seven (7") inches from the shell, and be of a weight so that the load of each tamper foot, with the drum empty, will be not less than 100 pounds per square inch of area in contact with a plane surface. Rolling shall be executed until the feet leave no appreciable imprint when the shell is filled to a maximum weight.
 - 2. Pneumatic tired rollers shall be suitable for ballast loading which will give a compression, under working conditions, of not less than 325 pounds per inch width of tire tread. Forward

and rear tires shall make separate tracks. Compaction shall be equivalent to that required for the sheeps foot roller.

3. Within the limits of the roadbed, the fill shall be constructed of selected clay materials from excavation and borrow, and be free from stones larger than four (4") inches in diameter. Slopes of roadway outside the above limits may be constructed of alternate layers of rock and clay; in no case shall rock be allowed in nests. The stones shall be uniformly distributed over the preceding clay layers, and the voids shall be completely filled with clay so as to form a solid compaction embankment.

- G. Clean existing surfaces of debris, dust, and loose material prior to tack coat application.

3.03 TACK COAT APPLICATION

- A. Apply tack coat uniformly to existing pavement or base course using a pressure distributor.
- B. Allow tack to break (turn black) before placing asphalt; protect from traffic until covered.
- C. Apply tack coat to contact surfaces of curbs, gutters, and adjacent pavement edges.
- D. Coat surfaces of manholes, catch basins, and frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

3.04 ASPHALT PAVEMENT

- A. Equipment: Use self-propelled pavers with automatic screed controls, per GDOT Section 400.
- B. Thickness:
 1. Binder Course: (if specified) As noted on drawings (minimum 2 inches compacted)
 2. Surface Course: As noted on the drawings (minimum 1.5 inches compacted)
- C. Placement: Lay in lifts not exceeding 3 inches uncompacted; ensure uniform texture and grade per drawings.

3.05 COMPACTION

- A. Equipment: Use steel-wheel rollers (8-12 tons) and pneumatic-tire rollers, per GDOT Section 400.
- B. Process:
 1. Begin compaction immediately after placement
 2. Compact to specified density, verified by field testing.
 3. Roll longitudinally, overlapping passes, until no roller marks remain; avoid over-compaction.
- C. Joints:
 1. Form longitudinal joints hot where possible; use cold joint sealant if paving is delayed.
 2. Offset transverse joints by 6 feet minimum between lifts; compact to match adjacent pavement.

3.06 FIELD QUALITY CONTROL

A. Testing and Tolerances:

1. Density: Test every 500 square yards using nuclear gauge (ASTM D2950) or core samples (ASTM D5361); meet specified density range.
2. Thickness: Verify with one core sample per 1,000 square yard; within ¼ inch of specified thickness.
3. Smoothness: Check with 10-foot straightedge; maximum ¼ inch deviation in 10 feet.
4. Elevation: Check with surveying equipment, within ½ inch of specified elevation.

B. Corrective Action: Remove and replace areas failing density, thickness, or smoothness requirements at no cost to Owner.

1. Defective areas shall be replaced by cutting to the full depth of the course. Cuts shall be made perpendicular and parallel to the direction of traffic with vertical edges.
2. A tack coat shall be applied to all exposed surfaces. The area shall be filled with fresh hot asphaltic concrete mix in lifts of the depth as the adjacent area and compacted to the specified surface density and smoothness.

3.07 PROTECTION AND CURING

A. Restrict traffic from newly paved surfaces for 24 hours or until pavement cools to 140°F, whichever is longer.

B. Protect edges from damage during adjacent construction activities.

3.08 SHOULDER CONSTRUCTION

A. Shoulders shall be constructed of selected topsoil in accordance with typical sections shown, and shall be grassed as specified elsewhere. Local quarry waste material may be used for base material meeting Section 310 of Highway Specifications, except for material passing No. 60 sieve which may be from 15 to 85 percent.

3.09 CLEANUP

A. Remove excess asphalt, debris, and construction materials from site.

B. Sweep paved surfaces clean prior to final acceptance.

3.10 ACCEPTANCE:

A. Final payment is subject to the Engineers acceptance for specified tolerances and trafficability.

END OF SECTION

SECTION 32 31 00

FENCING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fencing, posts, rails, and fittings
2. Swing Gates and Hardware

1.02 RELATED DOCUMENTS

A. Related Specifications

1. Section 32 31 19 - Cantilever Slide Gate
2. Section 31 10 00 - Site Clearing
3. Section 03 30 00 - Cast-In-Place Concrete

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM F567-23: Standard Practice for Installation of Chain-Link Fence
2. ASTM A491-11: Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
3. ASTM F104: Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
4. ASTM F1083: Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
5. ASTM F626): Specification for Fence Fittings.
6. ASTM F900: Specification for Industrial and Commercial Steel Swing Gates
7. ASTM A121-19: Specification for Metallic-Coated Carbon Steel Barbed Wire

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications for fencing materials, including fabric, posts, fittings, and appurtenances.
- B. Shop Drawings: Submit detail drawings showing fence and gate details including, but limited to, post size and spacing, bracing and support, and post encasement, .

1.05 DELIVERY AND STORAGE

- A. . Deliver materials in manufacturer's original packaging, undamaged.
- B. Store materials off ground, protected from weather, in a dry location until installation.

1.06 QUALITY ASSURANCE

- A. A. Installer Qualifications: Minimum 3 years' experience installing chain link fencing in Georgia or similar climate.
- B. Standards: Comply with ASTM F567 (Installation of Chain Link Fence)

1.07 PROJECT CONDITIONS

- A. Verify site grading and underground utilities prior to installation.
- B. Install fencing during dry weather conditions to ensure stable footing placement.

PART 2 - PRODUCTS

2.01 CHAIN LINK FABRIC

- A. Material: . Aluminum coated steel fabric, conforming to the latest revision of ASTM A 491).
- B. Mesh Size: 2-inch diamond pattern.
- C. Wire Gauge: 9-gauge (0.148-inch diameter).
- D. Height: 6 feet, unless otherwise specified on drawings.
- E. Selvage: Twist (barbed) at top and knuckle finish at bottom (unless otherwise noted on the drawings)

2.02 TENSION WIRE

- A. Bottom Tension Wire: 7-gauge, aluminum coated coil spring tension wire

2.03 POST AND RAILS

- A. Material: Galvanized steel, ASTM A123, minimum 1.8 oz/sf zinc coating
- B. Line Posts: 2 ½ -inch OD, Schedule 40 pipe, minimum 3.65 lbs/ft.
- C. Corner Posts: 3-inch OD, Schedule 40 pipe, minimum 5.79 lbs/ft. with necessary struts and tie bracing
- D. Gate Post: 4-inch OD, Schedule 40 pipe, minimum 9.11 lbs/ft with necessary struts and tie bracing
- E. Top Rail: 1-5/8-inch OD, Schedule 40 pipe, minimum 2.27 lbs/ft. with extra long pressed steel sleeves.
- F. Bracing: 1-5/8-inch OD, Schedule 40 pipe, minimum 2.27 lbs/ft and 3/8-inch truss rods as shown on the drawings.

2.04 FITTINGS AND HARDWARE

- A. Fittings: Galvanized steel, ASTM F626, including tension bars, bands, rail ends, and caps.
- B. Tie Wires: 9-gauge galvanized steel wire for securing fabric to posts and rails.

2.05 TOP BARBED WIRE

- A. Type: 12-½ gauge aluminum coated steel barbed wire with 4-point aluminum barbs spaced 5 inches apart.
- B. Quantity: 3 strands mounted on barbed wire support arms along top of fence.

2.06 GATES

- A. Provide gates of size, type and quantity noted on the drawings.
- B. Cantilever Slide Gate: Refer to Specification Section 32 31 19
- C. Swing Gates:
 - 1. Gate Frame: 2-inch OD, Schedule 40 pipe, minimum 2.72 lbs/ft. with welded corners and necessary braces and trusses.
 - 2. Fabric: Match chain link fabric in 2.01
 - 3. Gate Hardware:
 - a. Hinges: Heavy duty, adjustable, galvanized steel.
 - b. Latches: Heavy duty, drop rod latch with integrated locking mechanism. Provide with bronze padlock and duplicate master keys
 - c. Keepers: Heavy duty duckbill type.

2.07 CONCRETE:

- A. Refer to Section 03 30 00: Minimum 3,000 psi concrete required for setting post footings and ground keeper sleeve.

2.08 GROUNDING

- A. Grounding Rods: 10' x ¾" Copper unless noted otherwise on the drawings
- B. Wire: #4/0 bare copper ground wire

PART 3 - EXECUTION

3.01 GENERAL:

- A. Fencing shall be of the complete protection type with gates of size and type noted on the drawings.
- B. The fence shall have an overall height of 7 feet unless noted otherwise on the drawings.

3.02 PREPARATION

- A. Verify alignment and grade per site drawings; clear vegetation and debris along fence line.
- B. Mark post locations at maximum 10-foot intervals, adjusting for terrain and gate placement.

3.03 FENCE INSTALLATION

- A. Set posts in minimum 12-inch diameter concrete footings, 36 inches deep with an additional 9 inches of concrete below the bottom of the post.
- B. Space posts evenly, plumb, and aligned; allow concrete to cure 72 hours before attaching fabric.
- C. Top Rail: Install continuous through line post loops or barb arm loop top. Provide top rail in 21 foot length and splice with extra-long sleeves. The rail shall be secured to the terminal post by a brace band and rail end.
- D. Bracing: Install diagonal braces and truss rods at terminal posts and every fourth line post on runs exceeding 50 feet.
- E. Fabric:
 - 1. Stretch fabric taut using tension bars and bands at terminal posts.
 - a. Secure the tension bar to the terminal post with tension bands and 5/16 in carriage bolts spaced no greater than 12 inches (304.8mm) on center.
 - b. Chain link fabric to be sufficiently stretched taut so as not to deflect more than 3 in. in the center of two line post at mid height subjected to a 30 lb. horizontal force.
 - 2. Secure to line posts and top rail with tie wires at 12-inch intervals.
 - 3. Maintain 2-inch clearance above grade at bottom edge.
- F. Barbed Wire:
 - 1. Stretched taut between terminal posts and secured in the slots provided on the line post barb arms.
 - 2. Attach each strand of barbed wire to the terminal post using a brace band.
 - 3. Barb arms to be riveted or bolted to post.

3.04 GATE INSTALLATION

- A. Cantilever Slide Gate: Refer to Specification Section 32 31 19
- B. Swing Gates:
 - 1. Installation of swing gates and gateposts in compliance with ASTM F567.
 - 2. Direction of swing shall be as indicated on the drawings.
 - 3. Gates shall be plumb in the closed position having a bottom clearance of 3 in. grade permitting.

4. Hinge and latch offset opening space from the gate frame to the post shall be no greater than 3 in. in the closed position.
5. Double gate drop bar receivers shall be set in a concrete footing minimum 6 in. diameter 24 in. deep.
6. Gate leaf keepers (holdbacks) shall be installed for all double gates.

3.05 FENCE GROUNDING

- A. Unless otherwise noted on the drawings, chain link fencing shall be grounded as follows:
 1. At each gate (Personnel and Vehicle) install a buried 10' x 3/4" ground rod on inside of fence and bond a #4 ground wire to two posts, one on opposite side of gate.
 2. Connect to plant ground ring (if installed) with a #4/0 bare copper ground wire."

3.06 FIELD QUALITY CONTROL:

- A. Inspect for plumb posts, taut fabric, and secure fittings; adjust as needed.
- B. Test gate latches and keepers for secure engagement and resistance to manual force.
- C. Verify gate swings freely and latches consistently with keeper in place.

3.07 CLEANUP

- A. Remove excess materials, debris, and packaging from site upon completion.

END OF SECTION

SECTION 32 31 19

CANTILEVER SLIDE GATES

PART 1 - GENERAL:

1.01 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 SECTION INCLUDES:

- A. The work in this section shall include furnishing all labor, materials, equipment and appliances necessary to complete all Fortress Structural Gate and Hydraulic Operator System(s) required for this project in strict accordance with this specification section and drawings.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete.
 - 2. Section 05 50 00 – Metal Fabrications.
 - 3. Division 26 – Electrical.
 - 4. Division 28 – Electronic Safety and Security.

1.03 REFERENCES:

- A. Underwriters Laboratory Gate Operator Requirements (UL 325).
 - 1. Operators shall be built to UL325 standards and be listed by a testing laboratory. Complete all electrical work according to local codes and National Electrical code. All fieldwork shall be performed in a neat and professional manner, completed to journeyman standards.
 - 2. Current safety standards require the use of multiple external sensors to be capable of reversing the gate in either direction upon sensing an obstruction. Also see 2.02 D.
 - 3. Vehicle gates should never be used by pedestrians. Separate pedestrian gates must always be provided when foot traffic is present.
 - 4. Current safety standards require gate operators to be designed and labeled for specific usage classes. Hydraulic Operator TYM-HYD-VF2/3 gate operators are to be used on Class III and Class IV installations only.
- B. ASTM F 2200 – Standard Specification for Automated Vehicular Gate Construction.
- C. ASTM F 1184 – Standard Specification for Industrial and Commercial Horizontal Slide Gates, Type II, Class 2.
- D. American Welding Society AWS D1.2 Structural Welding Code.

1.04 SUBMITTAL:

A. Product Data:

1. Provide manufacturer's catalog cuts with printed specifications and installation instructions.
2. Deliver two (2) copies of operation and maintenance data covering the installed products, including name, address and telephone number of the nearest fully equipped service center.
3. Each operator shall bear a label indicating that the operator mechanism has been tested for full power and pressure of all hydraulic components, full stress tests of all mechanical components and electrical tests of all overload devices.

B. Shop Drawings:

1. Supply shop drawings showing the relationship of operating systems with gate components, including details of all major components.
2. Include complete details of gate construction, gate height, and post spacing dimensions.

C. Certification of Performance Criteria:

1. Manufacturer of gate system shall provide certification stating the gate system includes the following material components that provide superior performance and longevity. Alternate designs built to minimum standards that do not include these additional structural features shall not be accepted.
 - a. Gate track system shall be keyed to interlock into gate frame member (providing 200% additional strength when compared to weld only keyless systems). When interlocked with and welded to the "keyed" frame top member, gate track forms a composite structure.
 - b. Gate shall have a minimum counterbalance length of 50% opening width which provides a 36% increase in lateral resistance (when compared to ASTM minimum of 40% counterbalance). If gate is ever to be automated, counterbalance section shall be filled with fabric or other specified material.
 - c. To provide superior structural integrity, intermediate vertical members shall be used - with spacing between verticals to be less than 50% of the gate frame height.
 - d. Entire gate frame (including counterbalance section) shall include 2 adjustable stainless or galvanized steel cables (minimum 3/16") per bay to allow complete gate frame adjustment (maintaining strongest structural square and level orientation).
 - e. Gate truck assemblies shall be tested for continuous duty and shall have precision ground and hardened components. Bearings shall be pre-lubricated and contain shock resistant outer races and captured seals.
 - f. Gate truck assemblies shall be supported by a minimum 5/8" plated steel bolt with self aligning capability, rated to support a 2,000 # reaction load.
 - g. Hanger brackets shall be hot dipped galvanized steel with a minimum 3/8" thickness that is also gusseted for additional strength.

- h. Gate top track and supporting hangar bracket assemblies shall be certified by a licensed professional engineer to withstand a 2,000 lb. vertical reaction load without exceeding allowable stresses.

D. Certifications:

1. The Structural Cantilever Slide Gate must be cycle-tested and certified per section 2.04 B.
2. The aluminum welders and welding process for gate manufacture must be certified per section 2.04 C.
3. Operator Manufacturer: A company specializing in the manufacture of hydraulic gate operators of the type specified, with a minimum of ten years experience.
4. Manufacturer shall supply gate design performance certification as per section 1.03 C.

PART 2 - PRODUCTS:

2.01 HYDRAULIC GATE OPERATORS:

- A. Hydraulic Gate Operator TYM-HYD-VF2/3 with controller to be supplied by Tymetal Corp., 678 Wilbur Avenue, Greenwich, NY 12834 - (800) 328 – 4283.

1. Section 01 6000 – Product Requirements: Product selection procedures: Substitutions: Permitted.

2.02 OPERATION:

- A. Operation shall be by means of a metal rail passing between a pair of solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, geroller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300 pounds without the drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates weighing up to 5,000 pounds. The operator shall be speed controlled by an electronic Variable Frequency Drive (VFD) which will accelerate and decelerate the gate gradually to prevent shock loads to the gate and operator assembly. The maximum gate velocity of the Model TYM-HYD-VF2/3 operator shall be selectable between 26" (.66 m) per second and 36" (.91 m) per second. Upon starting, the VFD will gradually accelerate the gate to its maximum speed and when stopping, gradually reduce gate velocity to less than 1 foot per second, whereupon a limit switch will stop the electric motor. Two adjustable hydraulic brake valves (one for each direction) assist in slowing the gate to a precise stop.

- B. Standard mechanical components shall include as a minimum:

1. Supporting arms: Cast aluminum channel. Arms shall incorporate a fully bushed, 1-1/2" bronze bearing surface, acting on arm pivot pins. (item 2 below)
2. Arm pivot pins: 3/4" diameter, stainless steel, with integral tabs for ease of removal.
3. Tension spring: 2-1/2" heavy duty, 800 pound capacity.
4. Tension adjustment: Finger tightened nut, not requiring the use of tools.

5. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.
6. Limit switches: Fully adjustable, toggle types, with plug connection to control panel.
7. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories.
8. Chassis: 1/4" steel base plate, and 10 Ga. sides and back welded and ground smooth.
9. Cover: 10GA. sheet steel, hot-dip galvanized, and gasketed. Box shall be powder coated gray. All joints welded, filled and ground smooth. Finished corners square and true with no visible joints. The cover shall be locked with a detention quality mogul lock.
10. Finish: Fully zinc plated then finish coat of high gloss powder paint withstanding 1000-hour salt spray test.
11. Drive wheels: 8" Dia. Metal hub with polyurethane tread.
12. Drive rail: Shall be extruded 6061 T6, not less than 1/8" thick. Drive rail shall incorporate alignment pins for ease of replacement or splicing. Pins shall enable a perfect butt splice.
13. Hydraulic hose: Shall be 1/4" synthetic, rated to 2750 p.s.i.
14. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
15. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.
16. Hydraulic fluid: High viscosity index type with temperature range of -30F to 180F.
17. A zero to 2000-PSI pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.
18. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.
19. Heater with thermostat control for cold or damp climates.

C. Minimum standard electrical components:

1. Pump motor: Shall be a 2 HP, 56C, TEFC, three phase, continuous duty motor, with a service factor of 1.15, or greater. (Note, the VFD converts single phase to drive a three phase motor).
2. All components shall have overload protection.
3. Controls: Smart Touch Controller Board with 256K memory containing:
 - a. inherent entrapment sensor;
 - b. built in "warn before operate" system;
 - c. built in timer to close;
 - d. liquid crystal display for system configuration and reporting of control status;

- e. 23 programmable output relay options;
 - f. anti-tailgate mode;
 - g. built-in power surge/lightening strike protection;
 - h. Menu configuration, event logging and system diagnostics are easily accessible with a PC and free START software;
 - i. RS232 port for connection to laptop or other computer peripheral and RS485 connection of Master/Slave systems.
 - 4. Transformer: 75 VA, non-jumpered taps, for all common voltages.
 - 5. Control circuit: 24VDC.
 - 6. Power: 208 VAC three phase.
 - D. Obstruction Sensing Systems:
 - 1. The inherent motor current sensors are part of the gate operator system and may not be removed or bypassed.
 - 2. Required external sensors: See 1.02 A2. Specify photo eyes or gate edges or a combination thereof to be installed such that the gate is capable of reversing in either direction upon sensing an obstruction.
 - E. Optional control devices:
 - 1. card reader
 - 2. key-switch
 - 3. radio control
 - 4. vehicle detectors
 - 5. keypads
 - 6. seven day timers
- 2.03 FACTORY TESTING:
- A. Fully assemble and test, at the factory, each gate operator to assure smooth operation, sequencing and electrical connection integrity. Apply physical loads to the operator to simulate field conditions. Tests shall simulate physical and electrical loads equal to the fully rated capacity of the operator components.
 - B. Check all operator mechanical connections for tightness and alignment. Check all welds for completeness and continuity. Check welded corners and edges to assure they are square and straight.
 - C. Inspect operator painted finish for completeness and gloss. Touch up imperfections prior to shipment.

- D. Check all hydraulic hoses and electrical wires to assure that chafing cannot occur during shipping or operation.

2.04 STRUCTURAL CANTILEVER SLIDE GATE MANUFACTURERS:

- A. The cantilever sliding gate shall be manufactured by Tymetal Corp., 678 Wilbur Avenue, Greenwich, NY 12834 - (800) 328 - 4283.
 - 1. Section 01 6000 – Product Requirements: Product selection procedures: Substitutions: Permitted.
- B. Cantilever Slide Gate manufacturer shall submit test results stating that the gate panel has been tested in an operated system for 200,000 cycles.
- C. Gate manufacturer shall provide independent certification as to the use of a documented Welding Procedure Specification and Procedure Qualification Record to insure conformance to the AWS D1.2 welding code. Individual Certificates of Welder Qualification documenting successful completion of the requirements of the AWS D1.2 code shall also be provided.

2.05 STRUCTURAL CANTILEVER SLIDE GATE:

- A. Fortress Structural Cantilever Slide Gate System dimensions shall be as shown on the detail drawings.
- B. Structural Gate Frame:
 - 1. The gate frame shall be fabricated from 6063-T6 aluminum alloy extrusions. The top member shall be a 3" x 5" aluminum structural channel/tube extrusion weighing not less than 3.0 lb/lf (4.4kg/m). To maintain structural integrity this frame member shall be "keyed" to interlock with the "keyed" track member. If fabricated as a single horizontal piece, the bottom member shall be a 2" x 5" aluminum structural tube weighing not less than 2.0 lb/lf. If fabricated in two horizontal pieces, the bottom member shall be a 5" aluminum structural channel weighing not less than 2.65 lb/lf, and the two horizontal pieces or sections shall be spliced in the field (the gate frame shall be fabricated in one or multiple sections depending on size requirements or project constraints).
 - 2. Vertical Members:
 - a. The vertical members at the ends of the opening portion of the frame shall be "P" shaped in cross section with a nominal base dimension of no less than 2" x 2" (51mm x 51mm) and weighing not less than 1.6 lb/lf (2.3kg/m). The intermediate vertical members shall alternate between 2" x 2" (51mm x 51mm) and 1" x 2" (25mm x 51mm) in cross section weighing not less than 1.1 lb/lf (1.6kg/m) and 0.82 lb/lf (1.2kg/m) respectively.
 - b. Intermediate 1" x 2" (25mm x 51mm) vertical members weighing not less than .82 lb/lf shall alternate between 2" x 2" major members.
- C. Splicing:
 - 1. A ¼" x 5" x 24" galvanized steel splice plate shall be used to secure the two bottom channel members together utilizing eight (8) plated carriage bolts with lock nuts. The top members will be spliced together using a ¼" x 2" x 24" aluminum splice plate secured with six (6)

drive rivets on one side and welded to the top member on the other side. The track is overlapped onto the opposing section in an alternating fashion, interlocking with the top primary member.

D. Gate Track:

1. The gate shall have a separate semi-enclosed “keyed” track, extruded from 6005A-T61 or 6105-T5 aluminum alloy, weighing not less than 2.9 lb/lf. Track members are to be located on each side of the top member. When interlocked and welded to the “keyed” top member, it forms a composite structure with the top of the gate frame. Welds are to be placed alternately along the top and side of the track at 9" centers with welds being a minimum of 2" long.

E. All welds on the gate frame shall conform to Welding Procedure Specification and Procedure Qualification Record to insure conformance to the AWS D1.2 Structural Welding Code. All individual welders shall be certified to AWS D1.2 welding code. See 1.02 D.

F. Gate Mounting:

1. The gate frame is to be supported from the track by four (4) swivel type, self-aligning, 4-wheeled, sealed lubricant, ball-bearing truck assemblies.
2. The bottom of each support post shall have a bracket equipped with a pair of 3" (76mm) UHMW guide wheels. Wheel cover protectors shall be included with bottom guides to comply with UL325.
3. Gap protectors shall be provided and installed, compliant with ASTM F 2200.

G. Diagonal Bracing:

1. Diagonal "X" bracing of 3/16" or 1/4" diameter stainless or galvanized steel cable shall be installed throughout the entire gate frame.

H. Gate Filler:

1. Chain Link: 2" x 2" x 9 gauge aluminized steel chain link fabric shall extend the entire length of the gate (if operated gate, counterbalance must also have fabric to prevent reach through and comply with ASTM F 2200, see 1.03 C.1) Fabric shall be attached at each end of the gate frame by standard fence industry tension bars and tied at each 2" x 2" (51mm x 51mm) vertical member with standard fence industry ties. ASTM F 2200 requires attachment method that leaves no leading or bottom edge protrusions (cannot exceed 0.5 inch).

I. Posts:

1. Double sets of support posts shall be minimum 4" O.D. (102mm) round SS40 or 4" x 4" x 3/16" wall square steel tubing, grade 500. Gate posts shall be galvanized or coated and supported in concrete footings as specified by the design team.

J. Finish:

1. Gate to be mill finish aluminum or color coated with polyester powder as specified. If powder coated, the gate (including track member) and all accessories shall be pretreated chemically by sand blasting or other acceptable method to ensure proper coating adherence.

K. Gate Lock:

1. Gate system shall be furnished with an electro-mechanical lock. Lock shall be supplied with status indication and with a six tumbler mechanical lock. All gates shall be keyed alike. Lock requires additional 115V power supplied by others.

PART 3 - EXECUTION:

3.01 SITE INSPECTION:

- A. Final grades and installation conditions shall be examined. Installation shall not begin until all unsatisfactory conditions are corrected.
- B. Locate concrete mounting pad in accordance with approved shop drawings.
- C. Make sure that gate is level and operating smoothly under manual conditions before installation of gate operators. Do not proceed until gate panel is aligned and operates without binding.

3.02 INSTALLATION:

- A. Equipment in this section shall be installed in strict accordance with the company's printed instructions, current at the time of installation (unless otherwise shown on the contract drawings).
- B. Coordinate locations of operators with contract drawings, other trades and shop drawings.
- C. Installer shall insure that the electric service to the operator is at least 20 AMPS. Operator wattage is 2400.
- D. The gate and installation shall conform to:
 1. ASTM F 1184 standards for aluminum cantilever slide gates, Type II, Class 2.
 2. ASTM F 2200 standard specification for automated vehicular gate construction.
 3. UL325 standards.
- E. The installing contractor shall be responsible to ensure that appropriate external primary entrapment safety devices be installed for the specific site conditions to protect against all potential entrapment zones. Proper operation of these safety devices shall be verified and training as to the operation and maintenance of these devices for the users and owners shall be documented.

3.03 SYSTEM VALIDATION:

- A. The complete system shall be adjusted to assure it is performing properly. Test gate operator through a minimum of ten full cycles and adjust to ensure operation without binding, scraping or uneven motion. Test limit switches for proper "at rest" gate position.
- B. Gate lock shall be aligned properly to lock and unlock without binding. Test gate lock through a minimum of ten full cycles and verify secure locking.
- C. All anchor bolts shall be fully concealed in the finished installation.
- D. Test and Explain Safety Features:

1. Each system feature and device is a separate component of the gate system.
 2. Read and follow all instructions for each component.
 3. Ensure that all instructions for mechanical components, safety devices and the gate operator are available for everyone who will be using the gate system.
 4. The warning signs shipped with the gate operator must be installed in prominent position on both sides of the gate.
- E. Ensure the owner is clear with regard to the safety points concerning the basic operational guidelines of the safety features of the gate operator system. These safety points are listed in the operator manual and must be read prior to system use.

END OF SECTION

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes work related to seeding and sodding disturbed areas. Such areas shall be restored as nearly as possible to original or designed conditions.

1.02 RELATED DOCUMENTS

A. Related Specifications

1. Section 31 10 00 - Site Clearing
2. Section 31 20 00 – Earth Moving
3. Section 31 23 00 – Excavation and Fill
4. Section 31 23 33 - Trenching and Backfilling
5. Section 31 25 00 - Erosion and Sediment Control and Stormwater Monitoring
6. Section 32 92 10 – Landscaping and Irrigation

1.03 REFERENCES

1.04 SUBMITTALS

- A. Product Data: Submit sod supplier's certification of grass species, purity, and compliance with Georgia Department of Agriculture standards.
- B. Maintenance Plan: Submit schedule and procedures for watering, mowing, and fertilizing during establishment period

1.05 DELIVERY AND STORAGE

- A. Deliver sod within 24 hours of harvesting. Protect from drying and wind exposure during transport.
- B. Install sod within 36 hours of delivery; store in shaded area if delayed, keeping moist.

1.06 QUALITY ASSURANCE

- A. Sod Supplier: Minimum 5 years' experience producing turfgrass sod in Georgia or similar climate.
- B. Compliance: Materials and installation shall meet Georgia Turfgrass Association guidelines and applicable local codes

1.07 PROJECT CONDITIONS

- A. Install sod only when soil temperatures are above 60°F and below 95°F, typical for Georgia's planting seasons (April-May or September-October).
- B. Do not install during drought conditions unless irrigation is provided.

PART 2 - PRODUCTS

2.01 SOD

- A. Species: Sod species selection shall be as indicated on the drawings or selected by owner. Type of sod shall be determined by site and soil conditions.
- B. Purity: Minimum 98% pure strain, weed-free per Georgia Department of Agriculture standards.
- C. Cut: Uniform 1-inch thick sod with ½-inch soil base, harvested in rolls or slabs.
- D. Source: Grown in Georgia or adjacent states with similar soil and climate conditions.

2.02 GRASS SEED

- A. Species: Grass seed selection shall be in accordance with the "Manual for Erosion and Sediment Control in Georgia" as amended to date. Otherwise, the type of grass seed applied shall be determined by site and soil compatibility and Owner discretion.
 - 1. Grassing through established pastures and lawns shall be by seeding with the same type of grass as was disturbed or, if acceptable to the Owner, seeding may be as recommended by the local Soil Conservation Agent.
 - 2. Grassing along highway right of way shall be in accordance with Department of Transportation, State of Georgia, Standard Specifications, Construction of Roads and Bridges, 2013 Edition, Section 700.
- B. Purity: Minimum 95% pure seed, 85% germination rate, less than 0.5% weed seed.
- C. Source: Certified seed grown and tested in southeastern U.S., compliant with Georgia Department of Agriculture regulations.
- D. Application Rate: As recommended by the Manual for Erosion and Sediment Control or seed supplier for uniform coverage.

2.03 FERTILIZER

- A. Type: Slow-release granular, 6-12-12 (N-P-K) or as recommended by soil test.
- B. Application Rate: 1,500-pounds per acre and disced or harrowed into dampened soil or as recommended by soil test.

2.04 MULCH

- A. Type: Dry straw or hay, weed-free, or hydro-mulch with tackifier, suitable for erosion control on slopes.

- B. Application Rate: Straw at 2 to 2.5 tons per acre; hydro-mulch per manufacturer's instructions. Apply uniformly over the disturbed areas to achieve 75% coverage.
- C. Spreading: Spreading must be done by blower-type or other mulch-spreading equipment or by hand and anchored by pressing the mulch into the soil.
- D. Anchoring: Anchoring must be done immediately after the mulch is spread. A disk harrow with the disk set straight or a special "packer disk" may be used. The disk may be smooth or aerated and should be 20" or more in diameter and 8" to 12" apart. The edges of the disk should be dull enough not to cut the mulch but sharp enough to press into the soil leaving much of it in an erect position.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Scope: The Contractor shall grass all areas that were disturbed by clearing or construction operations. Grassing shall be by conventional seeding or hydroseeding. Contractor shall install sod in areas indicated on the drawings.
- B. Grassing (by seeding) shall be completed as soon as practical after finish grading is completed in order to minimize erosion from rainfall and runoff. Any erosion occurring in grassed areas shall be immediately repaired.
- C. Temporary Seeding: Temporary seeding is required on any areas exposed longer than 14 days.
- D. Permanent Grassing (Seeding or Sodding): Permanent grassing shall be done only if it can be completed between March 1st and April 15th or August 15th and November 15th. Use temporary seeding during remaining periods. The Contractor shall provide for later permanent seeding by obtaining a signed proposal to the Owner from an approved local landscaper for the work specified. The local landscaper shall complete all permanent grassing within the specified dates during the contractor's warranty period.
- E. Temporary and Permanent Seeding Mix: Temporary grass may be intermixed with permanent grass. However, the Contractor shall cut and maintain the temporary grass such that the permanent grass will become established and not be choked out.

3.02 PREPARATION

- A. Prior to seeding or sodding:
 - 1. Grade surface to ensure positive drainage and avoid low spots
 - 2. Spread the stored stock piled top soil over the entire area, working the better top soil into the more rocky areas.
 - 3. The entire area shall be smoothed with a drag and all clods broken up. All deleterious material, large stones, roots, limbs and other debris shall be removed to leave a smooth area that would be suitable for mowing.

3.03 PLANTING

A. Seeding

1. Seed, fertilizer, mulch and periodic watering shall be applied in adequate quantities to assure a satisfactory ground cover over the entire disturbed area of construction operations.
2. Application Methods:
 - a. Hydro-seeding: Mix the seed (inoculated if needed), fertilizer and wood cellulose or wood pulp fiber mulch with water and apply in slurry uniformly over the area to be treated. Apply within one hour after the mixture is made.
 - b. Broadcast: Broadcast seed evenly using a mechanical spreader. Apply seed at specified rate; overlap edges for uniformity. Rake lightly to cover seed with ¼-inch soil or as recommended by the supplier. Spread straw mulch on seeded areas to retain moisture.
3. Maintenance:
 - a. Watering: Unless otherwise recommended by the supplier, water thoroughly as soon as completed and at least twice daily, or more often if necessary to provide continuous growth without setback until all growth from seed is thoroughly established.
 - b. Mowing: Begin mowing when grass reaches 3-4 inches, after full germination, or as recommended by the supplier. The contractor will be required to maintain the grass on the site until the job is accepted.

B. SOD

1. Installation
 - a. Lay sod in staggered rows, with joints tightly butted and no overlaps.
 - b. Install along straight lines or contours as shown on drawings; trim edges neatly.
 - c. Roll lightly with a lawn roller to ensure soil contact, avoiding excessive compaction.
2. Maintenance:
 - a. Watering: Unless otherwise recommended by the supplier, water immediately after installation to a depth of 4 inches. Maintain moist soil (not saturated) for 14 days post-installation; 1 inch per week thereafter, adjusted for rainfall.
 - b. Mowing: Begin when grass reaches 3 inches; maintain at 1.5-2 inches height or as recommended by the supplier. The contractor will be required to maintain the grass on the site until the job is accepted.

3.04 ACCEPTANCE:

- A. Grass: Final acceptance and payment of grassing is defined as a full cover, over the seeded area of live and growing grass, when at least 98% of the total area has no bare spots exceeding 1 square foot, and the ground surface is fully stabilized against erosion. .

- B. Sod: Final acceptance and payment of sodding is defined as a full cover, uniformly green, rooted, and free of bare spots or disease. Sod shall be established for a minimum of 60 days or until turf withstands light foot traffic.

END OF SECTION

SECTION 32 92 10

LANDSCAPING AND IRRIGATION

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes designing and installing landscaping and irrigation system where indicated on the drawings.

1.02 RELATED DOCUMENTS

A. Related Specifications

- 1. Section 31 20 00 – Earth Moving
- 2. Section 31 23 00 – Excavation and Fill
- 3. Section 31 23 33 – Trenching and Backfilling
- 4. Section 31 25 00 – Erosion and Sediment Control and Stormwater Monitoring
- 5. Section 32 92 10 – Turf and Grasses
- 6. Section 33 05 31 – Thermoplastic Utility Pipe

1.03 REFERENCES

A. American National Standards Institute (ANSI)

- 1. ANSI Z60.1 - American Standard for Nursery Stock

B. American Society of Landscape Architects (ASLA)

- 1. Guidelines for landscape design and installation

C. Irrigation Association (IA)

- 1. Standards for landscape irrigation systems

1.04 SUBMITTALS

- A. Shop Drawings: Submit detailed plans for planting layout, irrigation design, and material specifications.

- 1. Provide rendering of proposed layout if requested for Owner's review and approval.

- B. Product Data: Provide manufacturer's data for irrigation components, mulch, soil amendments, and plant materials.

- C. Certifications: Submit nursery certifications for plant health and compliance with ANSI Z60.1

- D. Maintenance Plan: Submit a 12-month maintenance schedule for plantings and irrigation system

1.05 ALLOWANCE:

- A. Contractor shall include an allowance in the amount of **\$150,000** for providing a complete landscaping and irrigation system.
- B. The allowance shall cover the following:
 - 1. Professional design of landscaping and irrigation plan
 - 2. Installation by Landscaping Professional subcontractor
 - 3. Trees, plants, mulch, bedding, landscape fabric, irrigation piping and appurtenances, and all other materials required for a complete landscape and irrigation installation.
 - 4. Materials, taxes, freight, and other related fees
- C. The cost of Contractor's equipment, labor, overhead, and profit shall not be included in the allowance.
- D. Any remaining balance, after selection by the Owner, shall be deducted from the Contract amount in the final change order.

1.06 DELIVERY AND STORAGE

- A. Deliver healthy plants in suitable containers
- B. Plant materials shall be stored as appropriate for the species. The Contractor or the Landscaping subcontractor shall be responsible for watering and maintenance until planting and commissioning of the irrigation system.
- C. Install plants as quickly as practical.

1.07 QUALITY ASSURANCE

- A. Landscaping Professional shall have a minimum 5 years' experience in the installation of landscaping and irrigation systems.
- B. Sources for plants shall be from certified nurseries located within 200 miles of the project to ensure acclimatization.

1.08 PROJECT CONDITIONS

- A. Install plants only at temperatures and conditions appropriate for the species.

PART 2 - PRODUCTS

2.01 PLANTS

- A. Quality: Plants shall be healthy, vigorous, free of pests, diseases, and damage, and conform to ANSI Z60.1 standards.
- B. Species: Select native or adapted species suitable for [USDA Hardiness Zone or Local Climate].

C. Size:

1. Trees: Minimum 2-inch caliper, measured 6 inches above ground; minimum 8 ft height.
2. Shrubs: Minimum 3-gallon container size
3. Groundcovers: 1-gallon or 4-inch pots, spaced per design

2.02 SOIL AND AMMENDMENTS

- A. Provide topsoil, compost, mulch, fertilizer and other similar amendments as required for landscape construction.

2.03 IRRIGATION MATERIALS

A. Piping

1. Main Supply Lines: Provide in accordance with Section 33 05 31, Thermoplastic Utility Pipe
2. Laterals: SDR 21 or SDR 26 unless otherwise approved by the Engineer.
3. Valves: Brass or high-strength plastic gate valves, rated for 150 psi, per ASTM D1785
4. Sprinkler Heads: Pop-up spray heads or drip emitters for water-efficient irrigation as manufactured by Rainbird or equal.
5. Controller: Smart irrigation controller with weather-based sensors, compliant with EPA WaterSense standards.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION OF LANDSCAPED AREAS

- A. Clearing: Remove debris, rocks, and weeds from planting areas. Dispose of materials per local regulations.
- B. Grading: Grade site to ensure positive drainage, with slopes not exceeding 3:1 for turf areas.
- C. Soil Testing: Conduct soil tests to determine pH, nutrient levels, and drainage. Amend soil as needed based on test results.
- D. Trenching: Excavate trenches for irrigation lines, minimum 12 inches deep for mainlines and 8 inches for laterals

3.02 PLANTING

- A. Install landscaping per the Owner approved plan.
- B. Install trees, shrubs, and ground covers at depth and spacing as appropriate for the species
- C. Apply mulch around all plants.

3.03 IRRIGATION

- A. Layout: Install per approved irrigation plan, ensuring 100% coverage of landscaped areas.
- B. Pipe Installation: Lay pipes in trenches, ensuring no kinks or damage.
- C. Sprinkler Heads: Install heads flush with grade, adjusted for proper spray pattern and radius.
- D. Drip System: Install drip tubing in planting beds, with emitters spaced per plant water needs (e.g., 1–2 GPH per emitter).
- E. Controller Setup: Program controller for seasonal watering schedules, adhering to local water restrictions.
 - 1. Contractor shall provide all conduits, wiring, and other electrical components as required for powering the controller or other system components
- F. Testing: Pressure-test system at 100 psi for 1 hour to verify no leaks. Flush lines to remove debris.

3.04 QUALITY CONTROL

- A. Inspection: Verify plant placement, irrigation coverage, and system operation before backfilling. Damaged or unhealthy plants shall be removed and replaced with healthy specimens.
- B. Adjustments: Adjust sprinkler heads and drip emitters to avoid overspray onto hardscapes.
- C. Cleanup: Remove all construction debris and restore site to a clean condition.

3.05 MAINTENANCE

- A. Initial Establishment (90 Days)
 - 1. Watering: Irrigate per plant needs (e.g., trees: 10–15 gallons/week; turf: 1 inch/week). Adjust based on rainfall and soil moisture.
 - 2. Weeding: Remove weeds weekly to prevent competition with plantings.
 - 3. Fertilization: Apply slow-release fertilizer 30 days after planting, per soil test recommendations.
 - 4. Pruning: Prune only to remove dead or damaged branches during establishment.

3.06 WARRANTY

- A. Plants: 1-year warranty against failure due to poor stock or improper installation.
- B. Irrigation System: 2-year warranty on materials and workmanship, covering leaks, valve failures, and controller malfunctions.
- C. Replacements: Replace defective materials or plants at no cost to the owner during the warranty period.

END OF SECTION

SECTION 33 05 05

BURIED PIPE INSTALLATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes requirements for installation of buried piping system, including:
 - 1. Trench excavation and backfill for PVC and ductile iron pipe system
 - 2. Pipe bedding and installation for utility applications
 - 3. Thrust restraint for pressure systems (PVC and DIP)
 - 4. Polyethylene encasement for ductile iron pipe in corrosive soils
 - 5. Concrete encasement under slabs and structures
 - 6. Testing and inspection
- B. For installation of gravity sewers and drains refer to Section 33 31 13, Site Sanitary Sewerage and Gravity Piping

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 31 23 33 – Trenching and Backfilling
 - 2. Section 33 05 07 – Trenchless Installation of Utility Piping
 - 3. Section 33 05 19 – Ductile Iron Utility Piping
 - 4. Section 33 05 31 – Thermoplastic Utility Piping
 - 5. Section 33 05 60 – Concrete Manholes and Vaults
 - 6. Section 33 31 13 – Site Sanitary Sewer Gravity Pipe
 - 7. Section 33 42 00 – Stormwater Conveyance
 - 8. Section 40 05 51 – Common Requirements for Process Valves

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe

2. ASTM A536 - Standard Specification for Ductile Iron Castings
3. ASTM D3034 - Standard Specification for Type PSM PVC Sewer Pipe and Fittings
4. ASTM F679 - Standard Specification for PVC Large-Diameter Gravity Sewer Pipe and Fittings
5. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe
6. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
7. ASTM F1417 - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
8. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure Test

B. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. AWWA C150 - Thickness Design of Ductile-Iron Pipe
5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast
6. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances
7. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

C. DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA)

1. Installation Guide for Ductile Iron Pipe

1.04 SUBMITTALS

A. Product Data:

1. Submit pipe and fitting materials including class, coating, and lining details as required.
2. Polyethylene encasement materials for DIP
3. Trenchless pipe material including casing pipe, spacers, end seals, etc.
4. Warning tape and tracer wire specifications

B. Shop Drawings:

1. Pipe Layout: Detailed plan showing inverts, joint types, fittings, thrust restraints, and connections to structures for PVC and DIP systems

C. Testing Procedures:

1. Provide details on hydrostatic pressure testing protocol including proposed equipment for pressurizing system.
2. Deflection testing plan for PVC pipes (ASTM D3034/F679).
3. Low-pressure air testing for gravity pipes (ASTM F1417)
4. Test Reports: Submit test reports documenting test parameters and results for each test conducted.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Minimum 5-years experience in buried pipe installation
2. Successfully completed at least 3 similar projects in past 2 years
3. Work must be overseen by State of Georgia licensed Utility Foreman.

B. Regulatory Requirements:

1. Notify Georgia 811 "Call Before You Dig" or submit online dig ticket a minimum of 3 days prior to beginning excavations. Contractor shall adhere to all responses to the dig ticket.
2. Comply with OSHA requirements for trench safety
3. Follow local utility requirements

PART 2 - PRODUCTS

2.01 PIPE MATERIALS

A. Ductile Iron Pipe:

1. Refer to Section 33 05 19 Ductile Iron Utility Pipe
2. Refer to Section 40 05 19 Ductile Iron Process Pipe

B. PVC Pipe

1. Refer to Section 33 05 31 Thermoplastic Utility Pipe
2. Refer to Section 40 05 31 Thermoplastic Process Pipe

C. Stormwater Piping

1. Refer to Section 33 42 00 Stormwater Conveyance

D. Warning Tape:

1. Minimum 6 inches wide, color-coded (blue for water, green for sewer, purple for reuse).

2. Marked with utility identification (e.g., "CAUTION: WATER LINE BELOW").
3. Detectable metallic tape for PVC pipes

E. Tracer Wire (Thermoplastic Pipe Only)

1. 12 AWG minimum, solid copper, direct burial-rated insulation
2. Connectors to be waterproof, direct burial rated, twist-on or split-bolt type

2.02 CLASSIFICATION OF BEDDING AND BACKFILL MATERIAL.

A. Materials for bedding and backfill shall be classified as follows:

1. Class I: Manufactured Aggregates (Crushed Stone) Angular $\frac{1}{4}$ " to $\frac{3}{4}$ " graded stone. Latest revision of ASTM C 33 - Gradation #67 (ASTM #67) or #57 (ASTM #57) are acceptable.
2. Class II: Coarse sands and gravels with maximum particle size of $\frac{3}{4}$ " including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.
3. Class III: Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures.
4. Class IV: Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.
5. Class V: Fine-grained soil with high plasticity, organic soils, and soils containing frozen earth, debris, rocks larger than $1\frac{1}{2}$ " in diameter and other foreign materials. **Class V soils shall not be used for bedding or backfill unless directed otherwise by the Engineer**

2.03 TRENCH CONFIGURATIONS

A. Trench configurations shall be as noted in AWWA C151 as follows:

1. Type 1: Flat bottom trench of undisturbed earth with loose backfill
2. Type 2: Flat bottom trench of undisturbed earth with backfill lightly consolidated to the centerline of pipe
3. Type 3: Pipe bedded in minimum 4-inches of loose soil with backfill lightly consolidated to the top of pipe.
 - a. Loose soil is defined as native soil excavated from the trench, free of rocks, foreign materials, and frozen earth.
4. Type 4: Pipe bedded in sand, gravel, or crushed stone to a depth of $\frac{1}{8}$ pipe diameter, 4-inch minimum, with backfill compacted to top of pipe. (Approximately 80% Standard Proctor)
 - a. Bedding material shall be Class I or Class II

5. Type 5: Pipe bedded to its centerline in compacted granular material, 4-in minimum under pipe. Compacted granular or select material to top of pipe. (Approximately 90% Standard Proctor)
 - a. Granular material shall be Type I bedding material
 - b. Select material is defined as native soil excavated from the trench, free of rocks, foreign materials, and frozen earth.

2.04 BACKFILL MATERIAL

- A. Select Backfill: Excavated soil free of rocks over 3 inches, organic material, or debris; suitable for compaction.
 1. If excavated soil is not acceptable or available in sufficient quantities, Contractor shall provide select material acceptable to the Engineer.

2.05 TRENCHLESS PIPE MATERIAL

- A. Refer to Section 31 05 07, Trenchless Installation of Utility Pipe

2.06 THRUST RESTRAINT

- A. Mechanical Joint Restraints:

1. Refer to Sections:
 - a. Section 33 05 19 Ductile Iron Utility Pipe
 - b. Section 40 05 19 Ductile Iron Process Pipe
 - c. Section 33 05 31 Thermoplastic Utility Pipe
 - d. Section 40 05 31 Thermoplastic Process Pipe

- B. Concrete Thrust Blocks and Encasement:

1. Concrete shall be Class B or greater, air entrained, in accordance with Section 03 30 00
2. Placement of dry bag mixes will not be allowed.
3. If detailed drawings of thrust blocking requirements were not provided in the contract documents, concrete blocking shall be provided as recommended by the pipe/fitting manufacturer.

PART 3 - EXECUTION

3.01 GENERAL:

- A. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
- B. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from Engineer before proceeding.

- C. Engineer will observe excavations and bedding prior to laying pipe by Contractor. Notify Engineer in advance of excavating, bedding, pipe laying, and backfilling operations.
- D. Minimum cover over buried piping shall be 4 feet, unless otherwise shown or approved by Engineer.
- E. Excavation in excess of that required or shown, and that is not authorized by Engineer, shall be filled at Contractor's expense with select fill furnished, placed, and compacted in accordance with Section 31 20 00, Earth Moving.
- F. Sequence of Work:
 - 1. Excavation, cleaning, laying, jointing, and backfilling shall be kept up as closely as is possible so-as-to progress the work in a uniform workmanlike manner.
 - 2. In no case shall pipe be left in the trench overnight without completing the jointing.
 - 3. The completed pipe line shall not be left exposed in the trench unnecessarily; the Contractor shall backfill and compact the trench as soon as is possible after laying and jointing is completed.
 - 4. Each day at the close of work and at all times when laying is not in progress, the exposed end of the pipe line in the trench shall be closed with an approved head or barrier of wood or metal. If at any time it becomes necessary to cover the end of an incomplete pipe line with backfill, the end of that pipe shall be closed with a mechanical joint plug.

3.02 EXISTING UTILITIES

- A. Existing Pipelines: Where new pipelines parallel or crosses existing pipelines, the Contractor shall take precautions as necessary to ensure that such existing pipelines are not disturbed. Any damage to existing pipelines shall be promptly repaired at the Contractor's expense.
- B. Connections to Existing Pipelines: Connections to existing pipelines shall be made with the necessary fittings and valves as indicated on the drawings.
- C. Location: The Contractor shall, before opening pipeline trenches, locate the various points of connections to be made into existing pipelines and shall uncover as necessary for the Engineer to prescribe the type of connections and fittings to be installed.
- D. Interruption of Service: Connections to existing pipelines shall be made only at such times and in such a manner as will meet operating requirements. No cut shall be made in existing lines until the permission of the Owner's Superintendent of Utilities has been obtained as to time and manner of making the cuts and connections. All existing valves shall be operated only by authorized representatives of the Owner.
- E. Existing Underground Utilities and Obstructions: Certain existing water lines, culverts and cross drains are shown on the Drawings, according to the best information available to the Engineer. The Drawings indicate the pipelines to be laid over, under or around underground utilities or obstructions where such utilities or obstructions are known to exist. Where these or unforeseen underground utilities or obstructions are encountered, minimum depth of cover or the location and alignment may be changed upon written concurrence by the Engineer to avoid interference. The locations of the existing utilities are approximate only. The Contractor is responsible for determining the exact location of all utilities before beginning construction.

- F. The Contractor shall furnish and always have available an Electronic Pipe and Cable Finder in working order, for the purpose of locating existing pipelines or other obstructions in the way or are along the route of the new work.

3.03 TRENCH CONSTRUCTION

- A. Trenches shall be constructed of the configuration specified or otherwise indicated on the drawings.
 - 1. Alternate trench types may be required depending on the depth of bury, pipe class, and recommendations of the pipe manufacturer.
- B. Trenches shall be constructed to the line, grade and width shown on the drawings or otherwise specified.
- C. Trench depth shall be as noted on the drawing or as required for minimum cover plus any required bedding depth.
- D. Trench excavation and backfill shall be in accordance with Section 31 23 33 Trenching and Backfilling.
- E. Trench Width: Trench width shall be as required for placement, bedding, and backfill; placement of compaction equipment, and placement of shoring systems. In general, minimum trench widths shall be as follows:
 - 1. Minimum Trench Width for Pipe Excavations:
 - a. Ductile Iron Pipe: Pipe OD + 24 inches (12" each side)
 - b. PVC: Min. 18 inches or Pipe OD + 12 inches (whichever is greater).
 - c. Additional trench width may be required for shoring systems.
 - d. Narrower widths may be considered with prior approval from the Engineer.
- F. The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of pipe.
- G. Bell holes shall be provided at each joint to ensure the pipe barrel will lie flat on the trench bottom. Bell holes shall be no larger than necessary to allow joint assembly.

3.04 PLUGS:

- A. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
- B. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
- C. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
- D. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to Engineer.

3.05 SEPARATION OF SEWERS AND POTABLE WATER PIPING:

A. Horizontal Separation

1. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
2. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undisturbed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
3. Exception:
 - a. Where it is not possible to provide minimum horizontal separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test water main and sewer as specified in this Section prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.

B. Vertical Separation

1. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
2. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.
3. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted granular backfill for ten feet on each side of crossing.
4. Exceptions:
 - a. Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
 - b. Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

3.06 BEDDING PIPE:

- #### A. Bed pipe as specified and in accordance with the details on the Drawings or as noted in these specifications.
1. Trench excavation and backfill, and bedding materials shall conform to Section 31 23 33, Trenching and Backfilling, as applicable.
 2. Where Engineer deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance

with Section 31 23 33, Trenching and Backfilling. Payment for additional excavation and providing granular material will be made under the unit price payment items in the Contract.

3. Where pipe is installed in rock excavation, provide minimum of six inches of granular bedding material underneath the pipe.

3.07 PIPE INSTALLATION

A. Gravity Sewer and Drains: Refer to Section 33 31 13, Site Sanitary Sewerage Gravity Piping

B. Pressure Piping (Water and Force Mains)

1. Handling:

- a. Proper and suitable tools and equipment, for the safe and convenient handling and laying of pipe, shall be used; great care shall be taken to prevent the pipe and coatings from being damaged.
- b. Ductile iron pipe and fittings shall be carefully examined for cracks, broken lining or other defects.
- c. PVC pipe shall be carefully examined to ensure that pipe is homogenous throughout, free from cracks, nicks, gouges, severe scratches, etc.
- d. No pipe or other castings shall be laid which are known to be defective. If pipe and other castings are discovered to be cracked, broken or defective after being laid, it shall be removed and replaced with sound material, at no additional expense to the Owner.
- e. All pipe and fittings shall be thoroughly cleaned before being laid, and shall be kept clean until accepted in the complete work

2. Cleaning:

- a. The Contractor shall clean each joint of pipe while it is suspended before it is lowered into the trench.
- b. The Contractor shall keep exposed ends of the pipe properly plugged during laying to prevent dirt and other materials from entering the line, and shall, before the system is accepted, thoroughly clean all lines.

3. Alignment:

- a. Alignment and gradient shall be straight, however, the pipe line may be laid on a curve that is within the allowable laying radius and joint deflection, as recommended by the pipe manufacturer, both horizontal, and vertical.

4. Dewatering:

- a. Trenches shall be dewatered as specified in Section 31 23 33, Trenching and Backfilling.

5. Ductile Iron Pipe Installation:

- a. Ductile Iron Pipe Installation shall comply with AWWA C600 “Installation of Ductile Iron Water Mains and Their Appurtenances”
 - b. Cutting Ductile Iron Pipe:
 - 1) Cutting shall be done by skilled workmen, using an abrasive wheel cutter. Use of oxyacetylene torch will not be permitted.
 - 2) The plain end shall be beveled and inspected, any sharp edges, which might damage the gasket, shall be removed by means of a file or power grinder. Pipe that is cut in the field must be ground and beveled before assembly
 - c. Jointing Ductile Iron Pipe:
 - 1) Buried pipe shall have push-on joints and mechanical joint fittings. Restrained joints shall be provided were indicated on the drawings.
 - 2) Jointing shall be as recommended by the pipe manufacturer for the specified joint type.
 - 3) Gaskets and bell sockets shall be cleaned and lubricated prior to jointing.
 - 4) During assembly of the pipe, the joint must be kept straight while pushing. Pipe may be deflected if desired but only after the assembly is completed.
 - d. Laying Conditions:
 - 1) Earth Excavations:
 - a) Unless otherwise detailed on the drawings, trench configurations shall be Type I, II, III, IV, or V as recommended by the Pipe Manufacturer for the class of pipe and bury depth.
 - b) Pipes shall not be laid on loose rock or other hard materials.
 - 2) Rock Excavations:
 - a) Unless otherwise detailed on the drawings, trench configurations shall be Type IV or V with a minimum of 6” compacted Class I granular material under the pipe and as recommended by the Pipe Manufacturer for the class of pipe and bury depth.
6. PVC Pipe Installation
- a. PVC Pipe installation shall comply with AWWA Standard C605 (latest version) “Underground Installation of PVC Pressure Pipe and Fittings for Water”
 - b. Cutting PVC Pipe
 - 1) Cutting shall be done by skilled workmen using a hacksaw, a fine toothed hand saw or a power saw with a steel blade or abrasive discs.
 - 2) After cutting is complete, pipe shall be beveled with a beveling tool or similar equipment.

- 3) Before jointing section of pipe reference mark must be located on spigot end to insure proper jointing

c. Jointing PVC Pipe:

- 1) Buried pipe shall have push-on joints and ductile iron mechanical joint fittings unless noted otherwise. Restrained joints shall be provided where indicated on the drawings.
- 2) Jointing shall be as recommended by the pipe manufacturer for the specified joint type.
- 3) Gaskets and bell sockets shall be cleaned and lubricated prior to jointing. If necessary, groove shall be wiped with a clean, dry cloth. Care shall be taken to ensure that the proper ring is used. The rubber ring shall be wiped clean before it is inserted into the groove.

d. Laying Conditions:

1) Earth Excavations:

- a) Unless otherwise detailed on the drawings, trench configurations shall be Type I, II, III, IV, or V as recommended by the Pipe Manufacturer for the class of pipe and bury depth.
- b) Pipes shall not be laid on loose rock or other hard materials.

2) Rock Excavations:

- a) Unless otherwise detailed on the drawings, trench configurations shall be Type IV or V with a minimum of 6" compacted Class I granular material under the pipe and as recommended by the Pipe Manufacturer for the class of pipe and bury depth.

3.08 TRACER WIRE AND WARNING TAPE

- A. Tracer Wire: Before backfilling, tracer wire shall be installed longitudinally along the top of the pipe line. Locating wire shall be wrapped around the pipe at every 100 linear feet, and brought to within 24" of the finished grade. Provide tracer wire connector stations every 1,000 feet in meter vault or pressure treated 4x4 post (in areas that are not regularly maintained).

1. Tracer wire is required for all Thermoplastic Piping
2. Tracer wire is required for all Ductile Iron Pipe buried greater than 8'.

- B. Warning Tape: During backfill, install warning tape a minimum of 12 inches below the surface and approximately 24-36 inches above the pipe.

1. Warning Tape is required for all piping systems.

3.09 BACKFILLING

- A. All trenches shall be backfilled immediately after pipes are laid therein, and joints have been inspected by the Engineer, unless other protection of the pipe line is directed.

- B. When testing for leaks in open trenches, backfilling shall not be done until after all testing has been completed and all leaks eliminated.
- C. Selected Backfilling:
1. Selected backfill material shall consist of finely divided earthstone dust, sand, crushed stone, or other approved material carefully placed about the pipe and up to a height of at least 12" above the top of the pipe barrel, and in uniform layers not exceeding 6" in thickness, each layer thoroughly compacted with proper hand tools in a manner which will not disturb and/or injure the pipe.
 2. Backfilling shall be carried on simultaneously on both sides of the pipe and in a manner which will prevent injurious side pressures.
 3. If suitable select materials are not available from the trench excavation, the Contractor will be required to obtain the select materials elsewhere.
- D. General Backfilling:
1. After selected backfill material has been placed and tamped, the remainder of the trench may be backfilled with general excavated material, provided such material does not contain more than $\frac{1}{3}$ broken rock of which no single stone or boulder shall be larger than can easily be removed with a hand shovel.
 2. Backfill material shall be placed in uniform layers not exceeding 12" in thickness; each layer shall be thoroughly compacted with heavy-duty power tamping tools of the full satisfaction of the Engineer. The use of pneumatic power "Jumping Jack" tampers will not be permitted. Wherever the trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and finally made to conform to the surface of the ground.
 3. Backfilling shall be carefully performed, and the original surface restored to the full satisfaction of the Engineer.
 4. Surplus material shall be disposed of by the Contractor.
- E. Surface Dressing:
1. At locations outside streets, roads, walks, or other traveled ways open to vehicular or pedestrian travel, the backfill material shall be windrowed and maintained in a suitable manner so as to concentrate and pond rainfall runoff over the trench.
 2. After sufficient settlement has been obtained the Contractor shall complete surface dressing, remove surplus material, and clean up in accordance with these Specifications. Wherever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and finally made to conform to the surface of the ground. Backfilling shall be carefully performed and the original surface restored as specified herein.
- F. Areas Requiring Pavement Replacement:
1. Mechanical tamping will be required of all backfilling of excavated portions.
 2. After backfilling and tamping is completed the top 6" of the ditch shall be backfilled with Compacted Crushed Stone, ASTM C33 Gradation #67 or #57, as amended to date, with

sufficient fines for compaction. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with stone. Settlement in trenches shall be refilled with stone and such maintenance shall continue until replacement of pavement is authorized by the Engineer.

3.10 THRUST RESTRAINT

- A. Thrust restraints shall be installed at the following locations unless noted otherwise on the drawings:
 - 1. Bends
 - 2. Tees and branches
 - 3. Dead ends
 - 4. When indicated on the drawings, thrust restraints may also be required at valves, reducers, and other fittings.
- B. Concrete Thrust Blocks:
 - 1. Concrete thrust blocks shall be sized per details on the plans. If detailed drawings of thrust blocking requirements were not provided in the contract documents, concrete blocking shall be provided as recommended by the pipe/fitting manufacturer.
 - 2. The bearing surface of the concrete block must be against undisturbed soil. For soils with bearing capacities of less than 1500 PSF, the thrust block dimensions noted on the drawing shall be revised according to the Engineer.
 - 3. Pipe joints and bolts must remain accessible and kept clear of concrete.
 - 4. Concrete thrust blocks shall cure a minimum 7 days cure before pressure is applied to the piping system.
- C. Mechanical Restraints
 - 1. Mechanical joint restraints shall be used only with prior approval from the Engineer.

3.11 CONCRETE PIPE ENCASEMENT:

- A. Where shown, and where otherwise directed by the Engineer, the pipe shall be completely encased with Class 'B' concrete per Specification 03 30 00, Cast-In-Place Concrete
 - 1. Unless noted otherwise on the drawings, all piping below structural slabs and footings shall be encased in concrete.
- B. The trench shall first be excavated not less than 6" below the bell of the pipe and the pipe laid to line and grade on concrete blocking.
- C. Concrete shall then be poured to the full width of the trench, but in no case less than 6" from the pipe bell on either side of the pipe, and to a height of not less than 6" above the top of the pipe bell.
- D. No backfill material shall be placed in the trench for a period of at least 24 hours after the concrete encasement has been poured.

3.12 INSTALLATION BY BORING AND JACKING

- A. Where called for on the Drawings, pipes shall be installed by the boring and jacking method in accordance with Section 33 05 07, Trenchless Installation of Utility Piping.

3.13 POLYETHYLENE ENCASEMENT OF DUCTILE IRON PIPE

- A. Polyethylene encasement of ductile iron shall be installed where noted on the drawings
- B. Install in accordance with Specification 33 05 19, Ductile Iron Utility Pipe:

3.14 PRESSURE TESTING:

- A. When a section of pipe of a length deemed adequate by the Engineer is ready for testing, the line shall be thoroughly blown free from air and a leakage test made, and the Contractor shall furnish all labor, materials and equipment for carrying out these tests.
- B. Wherever conditions will permit, in the opinion of the Engineer, pipe lines shall be tested before the trench is backfilled. All joints then shall be examined during open trench test and all leaks entirely stopped.
- C. The Contractor shall furnish a test pump, and means for accurate measurement of water introduced into a line during testing, and shall furnish and install corporation stops at all high points in the line as required for blowing lines free from air and at the test pump location.
- D. The Contractor shall furnish, install and remove all temporary bulkheads, flanges or plugs, to permit the required pressure test, and shall furnish all equipment and labor to properly carry out such tests and to replace defective material.
- E. Test Pressure:
 - 1. Pressure and leakage testing shall be conducted in accordance with AWWA Standard C605 (latest version) "Underground Installation of PVC Pressure Pipe and Fittings for Water", and/or AWWA C600 "Installation of Ductile Iron Water Mains and Their Appurtenances" as appropriate.
 - 2. Test pressures shall be as follows:
 - a. Water lines: 200 PSI measured at the pipe line low point.
 - b. Force Mains: 150 PSI or 1.5 times the shutoff head of the pump, whichever is greater, measured at the pipe line low point. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section
 - c. Test pressures shall not vary by more than ± 5 -psi for the duration of the test.
 - 3. Leakage
 - a. Leakage allowed during the test shall be calculated using the following formula:

$$\text{PVC: } L = \frac{SD\sqrt{P}}{148,000} \quad \text{Ductile Iron: } L = \frac{SD\sqrt{P}}{133,200}$$

Where: L is allowable leakage in gallons/hour,
S is the length of pipe tested in feet,
D is pipe diameter in inches, and
P is test pressure is pounds per square inch (psi)

4. Minimum test period shall be two (2) hours; however, if, in the opinion of the Engineer, additional testing is required, such additional testing shall be performed by the Contractor at no additional expense to the Owner.

F. Payment: No separate payment will be made for the above work. The cost of the testing and all cost incidentals thereto, shall be included in the unit prices bid for the item to which the work pertains or including in the lump sum price as applicable.

3.15 DISINFECTION OF WATER LINES

- A. Disinfection of water lines shall be in accordance with Section 33 13 00, Disinfection of Water Systems.

3.16 FIELD QUALITY CONTROL

- A. Inspection

1. Contractor shall not backfill pipe lines until the Engineer has inspected the following:
 - a. Bedding prior to pipe installation
 - b. Joint assembly
 - c. Polyethylene encasement installation when applicable
 - d. Thrust restraints
 - e. Warning tape/tracer wire
2. During backfill operations compaction test shall be performed by third party testing agency where required in these specifications.

3.17 PROTECTION

- A. Installed pipe shall be protected from traffic loads, construction equipment, flooding, and debris.
- B. Damaged pipe shall be repaired immediately including:
 1. Replacing damaged pipe sections
 2. Repairing damaged coatings
 3. Replacing damaged polyethylene encasement
- C. Any subsequent settlement of backfill or pavement over trenches shall be replaced by the Contractor and the surfaces brought to grade.

3.18 CLEAN UP

- A. Before the work shall be considered complete, all material not used, and rubbish of every character, must be removed from the streets and placed at some point to be designated by the Owner
- B. All streets, sidewalks, curbs, fences and other private or public facilities and structures disturbed must be essentially in as good condition as existed before the work was done.

END OF SECTION

SECTION 33 05 07

TRENCHLESS INSTALLATION OF UTILITY PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes requirements trenchless installation of utility piping using:

1. Boring and Jacking methods

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

- B. Related Specifications

1. Section 31 23 33 – Trenching and Backfilling
2. Section 33 05 05 – Buried Piping Installation
3. Section 33 05 19 – Ductile Iron Utility Pipe
4. Section 33 05 31 – Thermoplastic Utility Pipe
5. Section 33 05 60 – Concrete Manholes and Vaults
6. Section 33 31 00 – Site Sanitary Sewer Gravity Pipe

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel (casing).
2. ASTM A139 - Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (casing).
3. ASTM C150 - Standard Specification for Portland Cement (grout).
4. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

- B. American Water Works Association (AWWA):

1. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
2. AWWA C900 - PVC Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In.
3. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
4. AWWA C605 - Underground Installation of PVC Pressure Pipe and Fittings for Water.

C. Other Standards:

1. American Railway Engineering and Maintenance-of-Way Association (AREMA) – Manual for Railway Engineering (if under rail).
2. OSHA 29 CFR 1926 Subpart P – Excavations (pit safety).

1.04 SUBMITTALS

A. Product Data:

1. Submit casing pipe, casing spacers, end seals, and accessories.

B. Trenchless Installation Plan:

1. Equipment specifications for boring machine and jacking rig capacity
2. Pilot hole alignment, grade control methods, and casing installation sequence.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Minimum 5-years experience in buried pipe installation
2. Successfully completed at least 3 similar projects in past 2 years
3. Work must be overseen by State of Georgia licensed Utility Foreman.

B. Regulatory Requirements:

1. Notify Georgia 811 “Call Before You Dig” or submit online dig ticket a minimum of 3 days prior to beginning excavations. Contractor shall adhere to all responses to the dig ticket.
2. Comply with OSHA requirements for trench safety
3. Follow local utility requirements

PART 2 - PRODUCTS

2.01 CARRIER PIPE

A. Carrier pipe shall be provided as noted on the drawings.

1. Ductile Iron Pipe: Refer to Section 33 05 19 Ductile Iron Utility Pipe
2. PVC Pipe: Refer to Section 33 05 31 Thermoplastic Utility Pipe

B. Carrier Pipe shall be provided with restrained joints unless noted otherwise on the drawings.

2.02 STEEL CASING PIPE

A. Steel pipe casing shall be manufactured from steel conforming to ASTM A252 Grade 2, as amended to date, with a minimum yield strength of 35,000-psi before cold forming. Pipe may be

straight seam or spiral weld. A protective coating will not be required unless otherwise noted on the drawings.

- B. Diameter and wall thickness of steel casing pipe shall be as shown on the Drawings.

2.03 CASING SPACERS

- A. Casing spacer shall be a two-piece shell per carrier pipe and made from T304 stainless steel of a minimum 14-gauge thickness, with 8 inch or 12 inch wide bands depending on application.
- B. Each shell section shall be lined with a 0.090" thick, ribbed PVC extrusion with a retaining section that overlaps the edges of the shell and prevents slippage. Liner shall have a hardness of 85-90 durometer.
- C. Bearing surfaces (runners) shall be ultra-high molecular weight polyethylene (UHMW) to provide abrasion resistance and a low coefficient of friction (0.12) with a variety of heights to meet desired position and a width of 1 ½ inches. The runners shall be mechanically bolted to the spacer.
- D. Risers shall be MIG welded to the shell, where applicable, and shall be made of T304 stainless steel of a maximum 10 gauge with bolt heads welded to the inside of the risers for strength and retention. Bottom risers 6" and over in height shall be reinforced. All reinforcing plates shall be 10 gauge T304 stainless steel and shall be MIG welded to mating parts.
- E. Width:
 - 1. Carrier Pipes less than 24 inches: 8 inches wide
 - 2. Carrier Pipe equal to or greater than 24 inches: 12 inches wide
- F. Number of Runners:
 - 1. Carrier Pipes less than 24 inches: 4 runners
 - 2. Carrier Pipe equal to or greater than 24 inches: 6 runners

2.04 END SEALS:

- A. End seals shall be either pull-on (PO) or wrap around (WR) and manufactured of 1/8 inch thick neoprene rubber with ½ inch T304 stainless steel bands.

PART 3 - EXECUTION

3.01 GENERAL:

3.02 INSTALLATION BY BORING AND JACKING

- A. Where called for on the Drawings, pipes shall be installed by the boring and jacking method.
- B. Equipment:
 - 1. Boring machine shall utilize an auger or pilot tube system, capable of maintaining ±0.5% grade and ±1 inch alignment tolerance.

2. Jacking Rig shall be hydraulic with a capacity exceeding the casing resistance.

C. Boring Pits:

1. A suitable boring pit shall be opened adjacent to the slope of the embankment or adjacent to point of bored and jacked section as shown on the Drawings.
2. The boring pit shall be long enough to accommodate the selected working room.
3. Guide timbers or rails for keeping the casing pipe on line and grade shall be accurately set and maintained in the bottom of the pit and with heavy timber back-stop supports installed at the rear of the pit to adequately take thrust of the jacks without any movement or distortion. It is important in the boring and jacking operation that extreme care be taken in setting all guides, rails and jacks such that the final position of the casing pipe be within the limits of acceptability for the placing and laying of the carrier pipe.

D. Boring and Jacking

1. Pilot Hole
 - a. Bore pilot hole along designed alignment and grade using auger or guided boring system.
 - b. Maintain tolerance: $\pm 0.5\%$ grade, ± 1 inch horizontal/vertical deviation.
 - c. Verify path with survey checks at 50-foot intervals or as obstructions are encountered.
2. Casing Installation:
 - a. Jack steel casing behind pilot hole using hydraulic rig, following bored path.
 - b. Weld casing joints full circumference (ASTM A139).
 - c. Remove spoil via auger or slurry; monitor jacking pressure to avoid overstress
3. Obstructions:
 - a. Stop work if boulders or utilities are encountered; notify engineer for resolution.
4. Alternate Method: An alternate method in which the casing is pushed into the fill or earth simultaneously as the boring auger drills out the ground is also acceptable.

E. Carrier Pipe Installation

1. Install spacers on carrier pipe as follows:
 - a. Spacing:
 - 1) Ductile Iron Pipe: One spacer shall be placed not more than 2 feet from the end of each casing with subsequent spacers placed at 8 foot intervals. No joint shall be more than 2 feet from a spacer.
 - 2) PVC Pipe: One spacer shall be placed on the spigot end of each segment and shall be in contact with the bell of the joint. Subsequent spacers shall be spaced at 6 foot intervals. No joint shall be more than 2 feet from a spacer.

- b. Positioning:
 - 1) Water or Force Mains shall be installed in the centered/restrained position unless noted otherwise on the drawings.
 - 2) Gravity Sewers and Drains shall be installed in the standard position unless noted otherwise on the drawings.
 - 2. Insertion:
 - a. Push or pull carrier pipe into casing, ensuring joint integrity
 - b. Maintain continuous contact with bedding or spacers; avoid point loading.
 - 3. Alignment: Verify carrier pipe grade and position match design
 - 4. End Seals: Seal ends using pull on (PO) or wrap around (WR) rubber seals.
- 3.03 CLEAN UP
- A. Before the work shall be considered complete, all material not used, and rubbish of every character, must be removed from the streets and placed at some point to be designated by the Owner
 - B. All streets, sidewalks, curbs, fences and other private or public facilities and structures disturbed must be essentially in as good condition as existed before the work was done.

END OF SECTION

SECTION 33 05 19

DUCTILE IRON UTILITY PIPE

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes ductile iron pipe and fittings for utility service, linings and coatings for chemical resistance, process-specific accessories and appurtenances, and testing and quality requirements
- B. Ductile iron pipe and fittings for utility systems
 - 1. Joint materials and restraints

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 31 23 33 – Trenching and Backfill
 - 2. Section 33 05 05 – Buried Pipe Installation
 - 3. Section 33 13 00 – Disinfection of Water Systems
 - 4. Section 33 31 13 – Site Sanitary Sewerage Gravity Piping
 - 5. Section 40 05 19 – Ductile Iron Process Pipe
 - 6. Section 40 05 51 – Common Requirements for Process Valves

1.03 REFERENCES

- A. American Water Works Association (AWWA)
 - 1. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 - 2. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems
 - 3. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings
 - 4. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 5. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 - 6. AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe
 - 7. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast

8. AWWA C153/A21.53 - Ductile-Iron Compact Fittings
 9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 - B. Ductile Iron Pipe Research Association (DIPRA):
 1. Installation Guide for Ductile Iron Pipe
 2. Thrust Restraint Design Manual
 3. Horizontal Directional Drilling with Ductile Iron Pipe
 - C. NSF International
 1. NSF 61 - Drinking Water System Components
- 1.04 SUBMITTALS
- A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00. Submit the following along with all items required per section 33 05 05 Buried Pipe Installation.
 - B. Product Data:
 1. Cutsheets and catalog information for pipe materials and pressure classes, fitting details and pressure ratings, and chemical resistance data.
 2. Gasket material temperature rating, pressure rating, and chemical compatibility.
 3. Pipe and fitting linings and coatings
 - C. Shop Drawings:
 1. Scaled detailed piping layout drawings showing all pipe, fittings, valves, gaskets, linings and coatings for the entire piping system.
 - D. Quality Assurance/Control Submittals:
 1. Manufacturer's certification of materials
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications:
 1. The manufacturer must have an ISO 9001 certified facility with at least five years of experience in process pipe manufacturing.
 2. Manufacturer to be a member of DIPRA
 - B. Installer Qualifications:
 1. The installer must have at least 5 years of experience in utility piping installation and demonstrated expertise with similar systems.

2. Installer must be a licensed Utility Contractor and all work shall be supervised by a licensed Utility Foreman.

C. Regulatory requirements:

1. Pipes and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, must be certified by an accredited organization in accordance with NSF 61.

1.06 DELIVERY AND STORAGE

A. Delivery:

1. Provide factory-applied end caps on pipes at the factory to keep debris, dust, and moisture from entering and potentially contaminating or damaging the pipe interior.
2. Label each pipe section with unique identifiers to ensure proper traceability and installation.
3. Protect flanged ends during shipping to bending, cracking, or distortion.
4. Provide coating protection during shipping.

B. Storage:

1. When possible, store pipes indoors to protect them from rain, direct sunlight, and temperature fluctuations.
2. If indoor storage isn't possible, use tarps, covers, or other protective materials to shield pipes from moisture, dust, and harsh weather.
3. Position pipes on stable, non-reactive blocking materials that prevent direct contact with the ground.

1.07 EXISTING CONDITIONS

- A. Verify field measurements prior to installation. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Acceptable Manufacturers:

1. American Cast Iron Pipe Company
2. U.S. Pipe
3. McWane Ductile
4. Or approved equal

B. Ductile Iron Pipe:

1. Flange pipe shall be fabricated per AWWA C115 / ANSI A21.15, pressure-rated per piping schedules, with minimum Thickness Class 53.
2. Non-Flanged Pipe shall conform to AWWA C151 / ANSI A21.51 for pressure, dimensions, tolerances, and markings.
 - a. Piping shall meet the following minimum pressure class unless noted otherwise.
 - 1) 3 to 12 inches - Pressure Class 350
 - 2) 14 to 24 inches - Pressure Class 250 (*Note 1*)
 - 3) 30inch and greater - Pressure Class 150 (*Note 1*)

Note 1: Higher Pressure Classes may be required depending on depth of bury and laying conditions.
3. Each pipe must undergo a hydrostatic pressure test of at least 500-psi at the point of manufacture.
4. All ductile iron pipes should be designed to a minimum of 150 psi working pressure, with a 100 psi surge allowance, and a 2:1 safety factor based on the combined working and surge pressures. Pipes should also meet single AASHTO H-20 truck loading, laying condition 2, and specified cover requirements.
5. Each pipe length must be clearly marked with its class or nominal thickness, net weight (unlined), casting period, manufacturer's mark, production year, and "D.I." or "Ductile Iron."

C. Fittings:

1. All fittings to meet requirements of AWWA C 110 / ANSI A21.10, or AWWA C153/ ANSI A21.53.
2. The pressure rating of the gaskets, bolts, and nuts should match the specifications set for mechanical or flanged joints.
3. The pressure rating of fittings shall meet the specified pressure rating or special thickness class of the connected pipe.

D. Pipe Joints:

1. General
 - a. Pipe joints shall meet requirements of AWWA C 110 / ANSI A21.10, or AWWA C153/ ANSI A21.53.
 - b. Pipe joints shall match the pressure rating of the piping system.
2. Flanged Joints:
 - a. Flange joints shall be provided for all exposed ductile iron piping above grade and in wetwells, vaults, or other similar structures unless noted otherwise on the drawings.

- b. Provide flat face flanges unless note otherwise.
 - c. Gaskets shall be 1/8-inch thick, ring or full-face design compatible with process fluid.
- 3. Push-On Joints:
 - a. Push-on joints, with mechanical joint fittings, shall be provide for all buried ductile iron piping unless noted otherwise on the drawings.
 - b. Each plain end should be marked with a circular stripe to serve as a visual guide to ensure proper joint assembly.
 - c. Products and Manufacturers:
 - 1) Fastite Joint by American Cast Iron Pipe Co.
 - 2) Tyton Joint by U.S. Pipe and Foundry Co.
 - 3) Tyton Joint by McWane Ductile
 - 4) Or equal.
- 4. Mechanical Joints:
 - a. Mechanical joints, with push-on pipe, shall be provided for all buried ductile iron piping unless noted otherwise drawings.
 - b. Mechanical joints shall be capable of meeting pressure rating or special thickness class, and test pressure per Section 33 05 05, Buried Piping Installation.
 - c. Supply mechanical joint with standard ductile iron retainer gland unless noted otherwise.
- 5. Restrained Joints:
 - a. Provide restrained joint ductile iron pipes and fittings where indicated on Drawings.
 - b. Restrained joints shall meet the indicated pressure class and consist of one of the following:
 - 1) Push-on Joints with restrained gaskets: Acceptable types include:
 - a) Amarillo “Fast-Grip” by American Cast Iron Pipe Co. (Up to 30”)
 - b) “Field-Lok” by U.S. Pipe and Foundry Co. (up to 24”)
 - c) Or Equal
 - 2) Push-on Joint with locking ring or similar mechanism. Acceptable types include
 - a) “HDSS” by US Pipe
 - b) “Flex-Ring” by American Cast Iron Pipe Co.

- c) “Lok-Ring” by American Cast Iron Pipe Co.
- d) “TR Flex” by McWane Ductile
- e) Or Equal
- c. Restrained Joint fittings shall be mechanical joint with wedge action gland. Acceptable types include:
 - a) One-Lock Series SLDE, by Sigma
 - b) Series 1100, by EBBA Iron Sales, Inc.
 - c) Stargrip Series 3000, by Star Pipe Products
 - d) Or equal.

2.02 GASKETS, HARDWARE, AND ACCESSORIES

A. Gasket Materials

- 1. Sewers: Styrene Butadiene Rubber (SBR) conforming to ANSI A21.11
- 2. Water: Styrene Butadiene Rubber (SBR) or EPDM in accordance with ANSI A21.11
 - a. Gaskets for potable water service must be NSF 61 compliant.
- 3. Air: FKM (Viton or equal)

B. Hardware

- 1. Bolts shall be ASTM A307 Grade A carbon steel with chamfered or rounded ends projecting $\frac{1}{4}$ to $\frac{1}{2}$ inch beyond the outer face of nut.
- 2. T-bolts for mechanical joint fittings shall be ASTM A307 Grade A carbon steel, minimum tensile strength of 60,000 psi). Bolt diameter shall be as recommended by the manufacturer.
- 3. Nuts to be ASTM A563, hexagonal, ANSI/ASME B18.2.2. Torque to manufacturer’s specifications.
- 4. Hardware located in the following environments, or where indicated on the Drawings, shall be 316 stainless steel.
 - a. Sewer wet wells
 - b. Submerged service
 - c. Chemicals
- 5. Provide plastic bolt sleeves and washers for insulating joints.

2.03 LININGS AND COATINGS

A. Interior Linings (select based on service):

1. Pipe and fittings shall be lined with a bituminous asphalt coating in accordance with AWWA C104 / ANSI A21.4 / NSF 61 for water applications, except as noted below:
 - a. Gravity sewer pipes shall be cement lined in accordance with AWWA C104 / ANSI A21.4.
 - b. Air pipe shall be unlined.
 - c. Grit pipe shall be unlined unless noted otherwise on the drawings.

B. Exterior Coatings:

1. Underground pipe and fittings shall be provided with an asphaltic coating in accordance with AWWA C151.
2. For exposed pipes and fittings provide a factory applied primer compatible with painting systems specified in the Painting Section 09 91 00.

2.04 POLYETHYLENE ENCASEMENT

A. Material:

1. AWWA C105 compliant, linear low-density polyethylene (LLDPE) or high density, cross-laminated polyethylene (HDCLPE) film
2. Minimum nominal thickness:
 - a. LLDPE: 8 mils
 - b. HDCLPE: 4 mils
3. Color: Black or blue (water), green (sewer)

B. Tape:

1. Thermoplastic material with pressure-sensitive adhesive
2. Minimum 2 inches wide
3. Weather and UV resistant, suitable for direct burial
- 4.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Inspect pipe and fittings for damage.
- B. Clean bell and spigot ends before jointing.

3.02 TRENCHING AND BACKFILLING

- A. Pipe trenches shall be excavated and backfilled in accordance with Section 31 23 33, Trenching and Backfilling Utilities
- 3.03 INSTALLATION OF DUCTILE IRON WATER LINES AND FORCE MAINS.
 - A. Buried water lines and force mains shall installed in accordance with Section 33 05 05, Buried Piping Installation
- 3.04 INSTALLATION OF GRAVITY SEWERS AND DRAINS
 - A. Buried gravity sewers and drains shall be installed in accordance with Section 33 31 13, Site Sanitary Sewerage Gravity Pipe.
- 3.05 PRESSURE TESTING WATER LINES AND FORCE MAINS.
 - A. Water lines and force mains shall be tested in accordance with Section 33 05 05, Buried Pipe Installation.
- 3.06 TESTING GRAVITY SEWERS AND DRAINS
 - A. Gravity sewers and drains shall be tested in accordance with Section 33 31 13, Site Sanitary Sewerage Gravity Piping
- 3.07 DISINFECTION OF POTABLE WATER LINE
 - A. Potable water lines shall be disinfected in accordance with AWWA C651 and Section 33 13 00, Disinfection of Water Systems.
- 3.08 POLYETHYLENE ENCASEMENT OF DUCTILE IRON PIPE
 - A. General:
 - 1. Polyethylene encasement of ductile iron shall be installed where noted on the drawings.
 - 2. Polyethylene encasements shall be installed per AWWA C105 (latest version)
 - B. Preparation:
 - 1. Prior to installation all lumps of clay, mud, cinders, and other similar shall be removed from the pipe.
 - 2. Soil embedment material shall not be trapped between the pipe and the polyethylene.
 - C. Installation:
 - 1. Install polyethylene per AWWA C105 Methods A, B, or C.
 - 2. Overlap joints minimum 12 inches
 - 3. Secure with tape at 3 foot intervals
 - 4. Repair any damage immediately.

END OF SECTION

SECTION 33 05 31

THERMOPLASTIC UTILITY PIPE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. PVC and HDPE pipe and fittings for utility piping systems.
2. Accessories and appurtenances for plastic piping systems.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 31 23 33 - Trenching and Backfilling
2. Section 33 05 05 - Buried Pipe Installation
3. Section 33 31 13 - Site Sanitary Sewerage Gravity Piping
4. Section 40 05 31 – Thermoplastic Process Pipe
5. Section 40 05 51 – Common Requirements for Process Valves

1.03 REFERENCES

A. American Water Works Association (AWWA)

B. ASTM International:

1. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid PVC Compounds and CPVC Compounds
2. ASTM D1785 – Standard Specification for PVC Plastic Pipe, Schedules 40, 80, and 120
3. ASTM D2447 – Standard Specification for PVC Plastic Pipe Fittings, Schedule 80
4. ASTM D2609 – Standard Specification for Plastic Insert Fittings for PE Plastic Pipe
5. ASTM D2737 – Standard Specification for PE Plastic Tubing
6. ASTM D2855 – Standard Practice for the Two-Step Method of Joining PVC or CPVC Pipe and Piping Components with Tapered Sockets
7. ASTM D3035 – Standard Specification for PE Plastic Pipe Based on Controlled Outside Diameter.

8. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe (PE) and Fittings Materials.
9. ASTM D3892 – Standard Practice for Packaging/Packing of Plastics
10. ASTM F402 – Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
11. ASTM F441 – Standard Specification for CPVC Plastic Pipe, Schedules 40 and 80
12. ASTM F449 – Standard Specification for CPVC Plastic Pipe Fittings, Schedule 80
13. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe based on Outside Diameter
14. ASTM F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
15. ASTM F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings and Crosslinked Polyethylene (PEX) Pipe and Tubing.

C. ASME Standards:

1. ASME B1.1 - Unified Inch Screw Threads
2. ASME B31.3 - Process Piping

D. NSF International:

1. NSF/ANSI 14 - Plastics Piping System Components and Related Materials
2. NSF/ANSI 61 - Drinking Water System Components

1.04 SUBMITTALS

A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00. Submit the following along with all items required per section 33 05 05 Buried Pipe Installation.

B. Product Data:

1. Cutsheets and catalog information for pipe materials and pressure classes, fitting details and pressure ratings, chemical resistance data, bolts, and flange ratings and facing types.
2. Gasket material temperature rating, pressure rating, and chemical compatibility.

C. Shop Drawings:

1. Scaled detailed piping layout drawings showing all pipe, fittings, valves, gaskets, linings and coatings for the entire piping system.
2. The drawings shall also include all hangar and support locations, expansion joint locations and the interface with equipment.

D. Quality Assurance/Control Submittals:

1. Manufacturer's certification of materials

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The manufacturer must have an ISO 9001 certified facility with at least five years of experience in process pipe manufacturing.

B. Installer Qualifications:

1. The installer must have at least 5 years of experience in utility piping installation and demonstrated expertise with similar systems.
2. Installer must be a licensed Utility Contractor and all work shall be supervised by a licensed Utility Foreman.

C. Regulatory requirements:

1. Pipes and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, must be certified by an accredited organization in accordance with NSF 61.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's packaging according to ASTM D3892.

B. Protect piping and tubing from puncture, abrasion, moisture, and ultraviolet radiation by storing according to manufacturer's recommendations.

1.07 EXISTING CONDITIONS

A. Verify field measurements prior to installation. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.01 PVC SEWERS AND DRAINS

A. Where indicated on the drawings, PVC pipe for sewers and gravity drains shall be provided as follows:

1. Polyvinyl Chloride (PVC) Pipe and Fittings, 4 – 15 inches
 - a. SDR 26 (PS 115) ASTM D3034
2. Polyvinyl Chloride (PVC) Pipe and Fittings, 18- 48 inches
 - a. PS115, ASTM D679
3. Joint Type:
 - a. Push-on, Integral bell and spigot (ASTM D3212) with elastomeric gaskets (ASTM F477), ,

4. Markings:
 - a. PVC pipe shall be marked at intervals of 5' or less with the following information: manufacturer's name or trademark, plant code, date of manufacturer, nominal pipe size, PVC cell classification, the legend "Type PSM DR 26 PVC Sewer Pipe," and ASTM designation D 3034.
 - b. Fittings shall be marked with the following information: manufacturer's name or trademark, nominal size, designations PVC and PSM and ASTM designation D 3034.
 - c. All markings shall remain legible during normal handling, storage and installation.
5. Color: Green

2.02 PVC FOR BURIED WATER LINES AND FORCE MAINS

- A. Where indicated on the drawings, PVC pipe for buried waterlines, force mains, and other pressure piping shall be provided as follows:
 1. Polyvinyl Chloride (PVC) Pipe and Fittings, Greater than 4 inches
 - a. Pipe: AWWA C900, ASTM D1784, Cell Class 12454
 - 1) Pressure Class
 - a) Force Mains: Minimum pressure Class 235 (DR 18)
 - b) Water (4"-15"): Minimum pressure Class 305 (DR 14)
 - 2) Joint Type: Integral bell and spigot (ASTM D3139) with elastomeric gaskets (ASTM F477); Push-on type
 - b. Fittings: Ductile Iron, Mechanical Joint Fittings, AWWA C110 or C153 in accordance with Specification 33 05 19, Ductile Iron Pipe
 2. Polyvinyl Chloride (PVC) Pipe and Fittings, less than 4 inches
 - a. Pipe: SDR 21, Pressure Class 200, ASTM D1784, Cell Class 12454, Iron Pipe Size
 - 1) Joint Type: Integral bell and spigot (ASTM D3139) with elastomeric gaskets (ASTM F477); Push-on type
 - b. Fittings: SDR 21, Pressure Class 200, Bell Joint per ASTM D3139 with elastomeric gaskets (ASTM F477); Push-on type.
 3. Markings:
 - a. PVC pipe shall be bear identification markings in accordance with AWWA C900 that will remain legible during normal handling, storage, and installation.
 - b. Fittings shall be marked with the following information: manufacturer's name or trademark, nominal size, designations PVC and PSM and ASTM designation D 3034.
 - c. All markings shall remain legible during normal handling, storage and installation.

4. Color:

- a. Sewer Force Mains: Green
- b. Potable Water: Blue
- c. Reuse Water: Purple

5. Certifications:

- a. PVC Pipe used for potable water service must be certified to meet the requirements of NSF 61.

2.03 PVC FOR ABOVE GROUND PROCESS APPLICATIONS

- A. Refer to Specification 40 05 31, Thermoplastic Process Pipe

PART 3 - EXECUTION

3.01 PREPARATION

- A. Inspect pipe for damage; cut and rebevel ends if defects exceed 10% wall thickness.
- B. Clean bell and spigot ends before jointing.

3.02 TRENCHING AND BACKFILLING

- A. Pipe trenches shall be excavated and backfilled in accordance with Section 31 23 33, Trenching and Backfilling Utilities

3.03 INSTALLATION OF PVC WATER LINES AND FORCE MAINS.

- A. Buried water lines and force mains shall installed in accordance with Section 33 05 05, Buried Piping Installation

3.04 INSTALLATION OF GRAVITY SEWERS AND DRAINS

- A. Buried gravity sewers and drains shall be installed in accordance with Section 33 31 13, Site Sanitary Sewerage Gravity Pipe.

3.05 PRESSURE TESTING WATER LINES AND FORCE MAINS.

- A. Water lines and force mains shall be tested in accordance with Section 33 05 05, Buried Pipe Installation.

3.06 TESTING GRAVITY SEWERS AND DRAINS

- A. Gravity sewers and drains shall be tested in accordance with Section 33 31 13, Site Sanitary Sewerage Gravity Piping

3.07 DISINFECTION OF POTABLE WATER LINE

- A. Potable water lines shall be disinfected in accordance with AWWA C651 and Section 33 13 00, Disinfection of Water Systems.

END OF SECTION

SECTION 33 05 60

CONCRETE MANHOLES AND VAULTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installing precast concrete manholes and vaults, including base sections, riser sections, eccentric or concentric cones, flat tops, grade rings, steps, and appurtenances for sanitary sewer, stormwater, or water utility systems

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 03 20 00 – Concrete Reinforcing
2. Section 03 33 00 – Cast-in-Place Concrete
3. Section 05 50 00 – Metal Fabrications
4. Section 31 23 33 – Trenching and Backfill
5. Section 33 05 05 – Buried Pipe Installation
6. Section 33 05 19 - Ductile Iron Utility Pipe
7. Section 33 05 31 - Thermoplastic Utility Pipe
8. Section 33 31 13 – Site Sanitary Sewerage Gravity Piping
9. Section 33 42 00 - Stormwater Conveyance

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
2. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
3. ASTM C150 - Standard Specification for Portland Cement
4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

5. ASTM C33 - Standard Specification for Concrete Aggregates
6. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

B. American Concrete Institute

1. CI 318 - Building Code Requirements for Structural Concrete
2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures (for sanitary sewer exposure)

1.04 SUBMITTALS

A. Product Data:

1. Submit manufacturer's data for precast concrete manholes/vaults, including dimensions, materials, joint seals, and load ratings.

B. Shop Drawings:

1. Provide detail drawings showing the following:
 - a. Manhole/vault configurations (base, risers, tops)
 - b. Pipe opening sizes, locations, and invert elevations
 - c. Reinforcement details and lifting provisions

C. Certifications

1. Submit certification that precast units meet ASTM C478 and specified strength requirements

D. Installation Instructions:

1. Submit manufacturer's procedures for handling, setting, and sealing.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Minimum 5 years' experience producing precast concrete manholes/vaults per ASTM C478.
2. Manufacturing plant shall be certified through the National Precast Concrete Association (NPCA)

B. Installer Qualifications:

1. The installer must have at least 5 years of experience in installing precast structures.
2. Installer must be a licensed Utility Contractor and all work shall be supervised by a licensed Utility Foreman.

1.06 DELIVERY AND STORAGE

A. Delivery:

1. Ship precast sections on pallets or cradles, labeled with size, type, and ASTM compliance.

B. Storage:

1. Store upright on level ground, supported to prevent tipping or rolling; protect from soil and weather exposure.

C. Handling:

1. Use lifting devices per manufacturer's design
2. Reject units with cracks >0.01 inch wide or exposed reinforcement.
3. Reject units with voids larger than ½ the wall thickness.

1.07 EXISTING CONDITIONS

- A. Verify field measurements and elevations prior to installation.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE STRUCTURES

A. Material:

1. Standard: ASTM C478, precast reinforced concrete
2. Concrete:
 - a. Cement: ASTM C150 Type II (sulfate resistant for sewer exposure)
 - b. Aggregate: ASTM C33, clean and graded
 - c. Compressive Strength: 4,000 psi minimum at 28 days
3. Reinforcement: ASTM A615 Grade 60 steel, deformed bars or welded wire fabric, minimum 0.12 sq in/ft in each direction.

B. Precast Manholes

1. Base Section:
 - a. Bottom of base sections shall be poured monolithically with the walls with a minimum thickness of 5 inches.
 - b. Base sections shall be furnished with inside diameters of 4', 5', and 6' as required.
 - c. Base sections shall be furnished with a minimum height of 24" for pipes having a diameter of 8", 10" or 12" and a minimum height of 36" for pipes having a diameter of 15" or 18". Minimum height for 5' or 6' diameter base sections shall be 48" regardless of pipe size.

- d. The opening in the base section for the accommodation of the pipe shall be cast to closely conform to job conditions and shall provide a minimum clearance of 3" between the inside bottom of the base and outside bottom of the pipe barrel.
- 2. Riser Sections:
 - a. Base sections with 5' or 6' inside diameters shall be reduced to 4' inside diameter by means of an adapter ring or transition top.
 - b. The riser sections shall be furnished in a minimum of 6" increments and shall have a 4' inside diameter, unless noted otherwise on the drawings. with one of the following:
 - 1) Tongue and groove joint to be sealed with a butyl rubber or bitumastic material.
 - 2) O-ring gasket type joint conforming to ASTM C 443, as amended to date.
 - c. The gasket joint shall be thoroughly cleaned of all loose materials and brushed with an epoxy to give a smooth surface free of any honeycomb. Manhole joints shall be externally sealed with a butyl rubber or bitumastic manhole joint wrap similar to Gator Wrap as manufactured by InFi-Shield. If an aerosol primer is used, the joint shall be thoroughly cleaned of all loose materials. The seal shall be designed and installed to prevent leakage of water through the joint sections of the manhole
- 3. Top Section: Eccentric cone (standard) or concentric cone/flat slab, reducing to 24-inch or 30-inch opening for frame/cover, minimum 8-inch thickness.
- 4. Grade Rings: Precast concrete, 2-inch to 6-inch heights, matching top opening ID.
 - a. The maximum adjustment for setting the frame and cover to grade shall be 8".
 - b. Brick will not be allowed to adjust manhole grade.
- C. Precast Vaults
 - 1. Rectangular or square, sized per drawings.
 - 2. Wall Thickness: Minimum 6 inches, or per structural design for HS-20 loading.
 - 3. Top Slab: Flat, with access openings per drawings, minimum 8-inch thickness.
- D. Joints:
 - 1. Type: Tongue-and-groove or bell-and-spigot, sealed with rubber gaskets per ASTM C443 (watertight to 13 psi) or butyl sealant (ASTM C990).
 - 2. Flexibility: Gaskets allow ± 2 -degree deflection without leakage.
- E. Pipe Openings:
 - 1. Precast or core-drilled, sized for pipe OD
 - 2. Sealed with flexible rubber boots (ASTM C923) or non-shrink grout (ASTM C1107)
 - a. Non-shrink grout may be used for sealing with prior approval from the Engineer.

F. Performance Requirements:

1. Loading: HS-20 traffic rating per AASHTO (16,000 lb wheel load), unless otherwise specified
2. Watertightness: No visible leakage at joints or pipe connections under 10 psi hydrostatic test or able to pass vacuum testing as provided in Part 3 of this specification.
3. Absorption: Absorption shall not exceed 9% when determined in accordance with ASTM C 497, as amended to date.
4. Durability: Resistant to hydrogen sulfide (H₂S) corrosion in sanitary sewers per ACI 350

2.02 PRECAST CONCRETE GRADE RINGS

- A. Precast concrete grade rings for final elevation adjustment of frames and covers shall be 4000 psi concrete with reinforcing wire or #3 reinforcing steel.
- B. Grade ring heights shall range from 2" to 9".

2.03 DROP MANHOLES

- A. Manholes having inlet sewers with drops greater than 24" may require drop connections as scheduled on the drawings.
- B. Drop manholes shall be constructed as detailed on the drawings.
- C. External drop pipes shall be encased in Class B concrete, per Section 03 33 00, or brick masonry unless noted otherwise on the drawings.

2.04 MANHOLE INVERTS

- A. Standard Site Built Inverts: Site built inverts shall be constructed of cement grout, Class B concrete per Section 03 33 00, or cement mortar brickwork. Cement mortar shall be made of 1 part cement and 2 parts clean sharp sand.
- B. Precast Inverts: Precast Inverts shall be constructed of 4000 psi concrete to match the material of the manhole. The curvature of the invert shall be as long as possible to allow a seamless flow through the manhole. The invert shall be ½ of the pipe diameter in height and sloping upward 2" to the inside wall of the manhole.

2.05 PRECAST CONCRETE ACCESSORIES

- A. Steps:
 1. Material: Polypropylene-coated steel or aluminum, per ASTM C478 Section 13
 2. Spacing: 14-16 inches vertical, centered on eccentric cone side, embedded 3 inches minimum
- B. Gaskets: Rubber, ASTM C443, resistant to sanitary sewage or stormwater
- C. Joint Sealant: Butyl rubber or modified bitumen based, ASTM C990, flexible gasket-type, non-shrinking. Provide primer as recommended by the manufacturer.

- D. Exterior Joint Wrap: Polyolefin backed butyl rubber, ASTM C877 Type III, Type A. CS-212 by ConSeal or equal
- E. Pipe Boots: Resilient EPDM or Polyisoprene rubber material conforming to ASTM C923 with stainless steel bands.

2.06 FRAMES AND COVERS:

- A. All manholes shall have a frame and cover to permit access. Frame and cover shall be constructed of cast iron or ductile iron and shall be rated per application.
- B. Frame and covers shall have a minimum of a 22 inch clear opening and be round built-up type.
- C. Frame and covers to be cast into flat slab tops may utilize a slab cast frame.
- D. All round built-up type frames shall have a minimum of 4 bolt holes drilled into the flange.
- E. All covers shall be stamped for the appropriate utility service on top such as “Sanitary Sewer” or “Storm Sewer”
- F. All manholes installed within the 100 year flood plain shall be a water tight frame and cover.
- G. Frames and Covers shall be provided as indicated below unless noted otherwise on the drawings:
 - 1. Standard Frame and Cover:
 - a. Location: All locations above the 100-year flood plain, including pavement areas, unless noted otherwise on the drawings.
 - b. Type: USF 668 Ring with KL Cover or equal
 - 1) Frame Height: 7 ½ inches
 - 2) Cover to be provided with 2 pick holes and 2 vent holes unless noted otherwise on the drawings.
 - 2. Standard Frame and Cover (Alternate for Height Adjustment)
 - a. Location: Same as Standard Frame and Cover but only where a shorter frame for height adjustment is necessary.
 - b. Type: USF 664 Ring with KL Cover or equal
 - 1) Frame Height: 4 inches minimum
 - 2) Cover to be provided with 2 pick holes and 2 vent holes unless noted otherwise on the drawings.
 - 3. Hinged Frame and Cover (Water Tight)
 - a. Location: Non-pavement areas for water tight applications (i.e. below 100 year flood zone) or other locations noted on the drawings.
 - b. Type: USF 924-US or equal

- 1) Frame Height: 4 inches minimum
 - 2) Frame and cover shall be gasketed to form a water tight seal.
 - 3) Frame and cover shall incorporate a locking mechanism to prevent unauthorized.
- c. Contractor shall provide a minimum of 2 sockets for operation of the cover's locking mechanism.

2.07 BEDDING MATERIAL

- A. Bedding material to be #57 Stone, clean and graded, for base support.

2.08 QUALITY ASSURANCE

- A. Testing and Stamping:

1. An inspection by an independent, accredited, testing laboratory of the manufacturer's plant and product may be required to assure conformity of the precast manholes to these Specifications and the minimum requirements of ASTM C 478, as amended to date. Each section of precast concrete manhole shall be stamped with the laboratory's stamp. Each stamped section shall indicate the laboratory's configuration that it was accepted in accordance with applicable ASTM Specifications. A copy of such report will be furnished to the Engineer with submittal of shop drawings for review in accordance with the General Requirements section of these Specifications. Job site inspection shall be visual for shape, uniformity and density.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verification:

1. Confirm manhole/vault sizes, invert elevations, and pipe openings match drawings.
2. Verify excavation and bedding conditions.

3.02 INSTALLATION OF PRECAST STRUCTURES

- A. Excavation:

1. Excavate for Precast Structures in accordance with applicable sections of 31 23 00, Excavation and Fill for Structures and Section 31 23 33, Trenching and Backfilling Utilities.

- B. Bedding:

1. Place 6-inch minimum layer of compacted crushed stone.
2. Ensure uniform support under base section; extend bedding 6 inches minimum beyond footprint of structure.

3. The crushed stone bedding shall be compacted under the entire length of pipe within manhole excavation

C. Placement:

1. Set base section plumb and to grade using laser or survey control (± 0.03 feet vertical tolerance)
2. Stack riser sections and cone/top, aligning joints; install gaskets or sealant per ASTM C443/C990.
3. Adjust to final grade with grade rings (max 12-inch total height); seal rings with mortar or sealant.

D. Joint Sealing

1. Apply rubber gaskets or butyl sealant between sections during stacking.
2. Wrap exterior joints with 12-inch-wide butyl wrap (ASTM C990) if specified for extra watertightness.

E. Pipe Connections:

1. Connections of pipe to manhole shall be made with a flexible joint system. The joint system shall be a boot or sleeve either cast or core drilled into the wall of manhole. The boot or sleeve shall be clamped and seated to the pipe with a stainless steel band.
2. Insert pipes into precast openings; secure with rubber boots (ASTM C923) or grout, ensuring watertight seal.
3. Precast pipe openings shall not exceed the deflection limits of the pipe connection (boot) or 7° , whichever is less.

F. Inverts

1. Form inverts in base with cement grout, Class B Concrete, or cement mortar and brick, or provide precast.
2. Channels shall be properly formed, rounded and troweled smooth.
3. The invert shall be $\frac{1}{2}$ of the pipe diameter in height and slope upward a minimum of 2 inches to the inside wall.
4. The curvature of the invert shall be as long as possible to allow a seamless flow through the manhole.
5. The connections of the sewer with the wall and channel of the manhole shall be tight and smooth.

G. Steps: Verify alignment and secure embedment; ensure no loose steps after installation

H. Frames and Covers:

1. Set Frames and Covers at elevations noted on the drawings.

2. Frames and covers in roads or right-of-ways, yards, or landscaped areas shall be set flush with the finished grade unless noted otherwise on the drawings.
3. Frames and covers in offsite locations such as sewer easements shall be set 18 inches above finished grade unless noted otherwise on the drawings.
4. Final Adjustment: Final grade for manhole frame and covers shall be set using reinforced concrete grade rings or steel riser rings for finer adjustment. Where the adjustment is greater than 9", the cone section shall be removed and a standard riser section shall be installed to acquire final grade. Steel ring risers shall fit tight into frame or have set screws to lock the ring into the frame section and prevent excess movement within the frame.
 - a. Adjustment of frame and cover using brick shall not be permitted without prior approval from the Engineer.

3.03 BACKFILL OF PRECAST STRUCTURES

- A. Backfill: Manholes shall be mechanically compacted in 12" lifts symmetrically around the perimeter of the manhole up to the frame and cover. Compaction densities shall be in accordance with these specifications.

3.04 ALTERATION OF MANHOLES

- A. In the event that the manhole has to be altered after delivery to job site the Contractor may core a new or additional hole in the side of the manhole. A rubber boot shall be installed to provide a watertight seal between the base section and pipe. All unused wall penetrations shall be sealed with a rubber boot and PVC plug.

3.05 REPAIRED AND PATCHED SECTIONS

- A. Repaired and patched sections will not be acceptable unless each individual section so repaired or patched shall have first been inspected by the Engineer for repair and patching at the manhole plant. Repairs to and patching of "O"-ring grooves and shoulders **will not be** permitted.

3.06 TESTING PRECAST CONCRETE STRUCTURES

A. Manhole Vacuum Testing

1. All manholes shall be vacuum tested in accordance with ASTM C 1244, "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test" as amended to date.
2. All pipes entering the manhole should be plugged, taking care to securely place the plug from being drawn into the manhole.
3. The test head shall be placed near the top of the manhole frame and cover and the seal inflated in accordance with the manufacturer's recommendations.
4. A vacuum pump of 10" of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9". Following are minimum allowable test times for manhole acceptance at the specified vacuum drop:
- 5.

<i>Depth</i>	<i>Time (Seconds)</i>		
	<i>48" Diameter</i>	<i>60" Diameter</i>	<i>72" Diameter</i>
4'	10	13	16
8'	20	26	33
12'	30	39	49
16'	40	52	67
20'	50	65	81
24'	59	78	97
Add 2' more depth	5	6.66	8

Note: These numbers have been taken from ASTM C 1244-93 (reapproved 2000).

6. If the manhole fails the initial test, repairs and adjustments necessary due to extenuating circumstances (i.e. pipe joint, plug sealing) should be made. Retesting shall proceed until a satisfactory test is obtained.
7. A final visual inspection shall be made by the inspector and Contractor. Any deficiencies noticed shall be repaired accordingly.
8. The cost for testing each manhole shall be included in the cost per vertical foot to install the pre-cast concrete manhole. Retest cost required due to defects in the Contractor's work, shall be paid by the Contractor.
9. Testing shall be performed on all new or refurbished manholes.

B. Non-Vacuum Testing

1. For doghouse manholes, the Engineer may approve non-vacuum testing as follows:
 - a. Fill water to 24" above highest pipe crown. Leaks in concrete or at pipe opening shall be repaired and retested.
 - b. In areas with high groundwater tables, Engineer may approve infiltration testing.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF WATER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Disinfection of potable water distribution systems
2. Disinfection of water storage facilities
3. Testing and reporting results

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 33 05 05 – Buried Pipe Installation
2. Section 33 05 19 – Ductile Iron Utility Pipe
3. Section 33 05 31 – Thermoplastic Utility Pipe
4. Section 33 16 00 - Water Utility Storage Tanks
5. Section 40 05 19 – Duction Iron Process Pipe
6. Section 40 05 23 – Stainless Steel Process Pipe and Tubing
7. Section 40 05 31 – Thermoplastic Process Pipe
8. Division 46 – Water Treatment Equipment

1.03 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites
2. AWWA B301 - Liquid Chlorine
3. AWWA C651 - Disinfecting Water Mains
4. AWWA C652 - Disinfection of Water Storage Facilities
5. AWWA C653 - Disinfection of Water Treatment Plants

B. Standard Methods for the Examination of Water and Wastewater, latest edition

C. Georgia Rules for Safe Drinking Water

1.04 SUBMITTALS

- A. Submit a disinfection plan detailing the methods and procedures to be used. The plan shall include:
 - 1. Proposed AWWA method to be used
 - 2. Type of disinfectant to be used and calculations of dosage
 - 3. Procedures and equipment to be used for disinfectant application
 - 4. Name and certification number of proposed Testing Lab for bacteriological analysis.
- B. Submit final Test Reports confirming effectiveness of the disinfection. Results shall include bacteriological, residual chlorine, and pH measurements.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with applicable state and local regulations
- B. Qualifications:
 - 1. Company and personnel performing disinfection shall have minimum 5 years experience
 - 2. Testing laboratory shall be certified for drinking water analysis

PART 2 - PRODUCTS

2.01 DISINFECTANTS

- A. Provide disinfectants in accordance with the requirements of AWWA C651, AWWA C652, or AWWA C653 as applicable.
 - 1. Sodium Hypochlorite: AWWA B300
 - 2. Liquid Chlorine: AWWA B301
 - 3. Calcium Hypochlorite: AWWA B300

2.02 TESTING SUPPLIES:

- A. Provide testing supplies as required by testing laboratory including sterile sample bottles, chlorine test kits, and pH test kits or meters.

2.03 PIPE SAMPLE POINT CONNECTIONS

- A. Sample point connections shall include corporation stop, tubing, and new curb stop. Connection shall be made with new $\frac{3}{4}$ " corporation stop at main and $\frac{3}{4}$ " tubing, from corporation stop to new $\frac{3}{4}$ " curb stop at 1-foot above ground level.

1. Corporation Stops: Shall have standard corporation stop thread conforming to AWWA Standard C-800 on the inlet end, with pack joint connection for connection to ¾" tubing.
2. Service Tubing and Fitting: Service tubing shall be ¾" copper Type K conforming to AWWA C-800 and ASTM B-88. Fittings shall be red brass as manufactured by Mueller or equal. Dielectric adapters shall be provided where copper or brass pipe connects to steel.
3. Pipe Saddle: Saddles shall be used with corporation stop for sample point connections to DIP water mains 6" and larger. Saddle shall be triple strap service saddle with ductile iron body, stainless steel straps, and grade 60 (Buna-N) rubber gasket. Saddles shall be Smith Blair Model No. 366, or equal. Connections to small lines shall be made with Ford Brass Saddle No. 5-70, or equal

PART 3 - EXECUTION

3.01 GENERAL

A. Protection:

1. Protect valve operators, hydrants, and other system components from excess chlorine
2. Install temporary connections as needed for disinfection
3. Place signs reading "Water Under Disinfection - Do Not Drink" at key points

3.02 WATER LINE DISINFECTION

A. Preparation

1. Sample Connections: Contractor shall install sample point connections as required by AWWA C651. At least one sample connection shall be installed every 1,200 feet of new water line plus one connection at each end of the pipe. Additional sample connections shall be provided at the end of each branch greater than one pipe joint in length.
 - a. If trench water has entered the new water line during construction or if, in the opinion of the Engineer, excessive quantities of dirt or debris have entered the new main, additional sample taps shall be installed at approximately 200 foot intervals.
 - b. Fire hydrants, blow-offs, and other similar fixtures shall not be used as sample points unless otherwise approved by the Engineer.

B. System Isolation:

1. Unless otherwise approved by the Engineer, the new water main shall be kept isolated from the active distribution system by physical separation until satisfactory bacteriological testing has been completed and the disinfectant water flushed out. Water required to fill the new main for hydrostatic pressure testing, disinfection and flushing shall be supplied through a temporary connection between the distribution system and the new main. The temporary connection shall include an appropriate cross-connection control device consistent with the degree of hazard and shall be disconnected (physically separated) from the new main during the hydrostatic pressure test. It will be necessary to reestablish the temporary connection

after completion of the hydrostatic pressure test to flush out the disinfectant water prior to final connection of the new main to the distribution system.

C. Cleaning and Flushing

1. Contractor shall take every precaution to prevent dirt, debris, and trench water from entering the pipe during construction.
2. During construction and prior to disinfection, Contractor shall thoroughly clean pipe, fittings, and appurtenances to remove dirt, debris, and other contaminants
3. Before the main is chlorinated, it shall be filled to eliminate air pockets and shall be flushed to remove particulates. A flushing velocity of not less than 2.5 feet/second is usually maintained in pipe sizes less than 24" in diameter. For larger diameter mains, an alternative to flushing, such as broom-sweeping of the main, is acceptable prior to chlorinating the main. System flushing shall be in accordance with AWWA C-651.

D. Disinfection Procedures

1. General Requirements:
 - a. Follow requirements of AWWA C651
2. Methods:
 - a. Continuous Feed Method:
 - 1) Fill main with potable water at controlled rate not to exceed 1 ft/s.
 - 2) At a point not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine.
 - 3) An initial chlorine concentration of not less than 25 mg/L shall be verified at all sample taps and the solution shall remain in the pipes for a 24-hour period.
 - 4) At the end of the 24-hour period, a chlorine concentration of not less than 10 mg/L shall be verified at all sample locations.
 - b. Slug Method (Only allowed with approval by the Engineer for special circumstances)
 - 1) Fill main with potable water at controlled rate.
 - 2) At a point not more than 10 ft downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine
 - 3) The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or "slug" of chlorinate water that will, at it moves through the main, expose all interior surfaces to a concentration of 100 mg/L for at least 3 hours.
 - 4) The free chlorine residual shall be measured in the slug as it moves through the main. If at any time free chlorine drops below 50 mg/L the flow shall be

stopped and chlorine reapplied to restore the free chlorine in the slug to not less than 100 mg/L

c. Tablet Method: (**Not allowed**)

- 1) The tablet method or disinfection which consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is complete is **NOT** allowed.

E. Final Flushing:

1. Upon completion of the sterilization, all mains and piping shall be thoroughly flushed before placing in service.
2. All chlorinated water shall be disposed of in a procedure acceptable to the Georgia Environmental Protection Division. The heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals such as sulfur dioxide, sodium bisulfite, sodium sulfite or sodium thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted.
3. Flush all lines until residual is below 2 mg/L or equal to existing system .

F. Sampling and Testing:

1. After final flushing and before the water main is placed into service, two consecutive sets of water samples, taken at least 24 hours apart, shall be collected from the main per AWWA C651 and tested for microbiological quality by a Georgia Environmental Protection Division approved laboratory in accordance with Georgia Rules for Safe Drinking Water, Chapter 391-3-5.
2. Samples shall be collected every 1,200 feet of new water line plus one at each end of the pipe. Additional samples shall be collected at the end of each branch greater than one pipe joint in length
3. For acceptance, the laboratory results for all samples must show:
 - a. Zero coliform bacteria present
 - b. Minimum 0.2 mg/L free chlorine residual
 - c. pH between 7.0 and 8.5

G. Redisinfection:

1. If the initial disinfection fails to produce satisfactory bacteriological results or if the water quality is affected, the new main may be reflushed and resampled as noted above.
2. If check samples also fail to produce acceptable results, the main shall be rechlorinated until satisfactory results are obtained.

3.03 WATER STORAGE FACILITY DISINFECTION

A. Preparation

1. Remove all construction materials such as scaffolding, planks, tools, rags and other materials not part of the structure.
2. Check all vent screens, overflows, pipe penetrations, or other similar opening to prevent possible contamination.

B. Cleaning

1. All surfaces including floors, walls, and ceilings (where applicable) shall be cleaned thoroughly using high-pressure water jet, sweeping, scrubbing or equally effective means. All water, dirt, and foreign material accumulated during the cleaning process shall be removed from the storage facility.

C. Disinfection Procedures

1. General Requirements:

- a. Follow requirements of AWWA C652

2. Methods:

a. Method 1:

- 1) Fill water-storage facility to overflow level with potable water to which a hypochlorite solution is added to provide a free chlorine residual of not less than 10 mg/L at the end of the 24-hour period.
- 2) Disinfected water shall remain in the water-storage facility for a period of not less than 24-hours and have a minimum free chlorine concentration of 10 mg/L at the end of the period.

b. Method 2

- 1) A solution of 200 mg/L available chlorine shall be applied directly to the surfaces that would be in contact with water when the storage facility is full to the overflow elevation
- 2) A solution shall be applied to any inaccessible drains or other piping such that it will have an available chlorine of not less than 10 mg/L when filled with water. Overflow piping does not need to be disinfected.
- 3) The disinfected surfaces shall remain in contact with the strong chlorine solutions for a minimum of 30 minutes. After which, water shall be admitted, the drains and other piping purged of the 10 mg/L chlorinated water, and the storage facility filled to the overflow level.

c. Method 3

- 1) Water and chlorine solution shall be added to the storage facility in amounts that the solution will initially contain 50 mg/L available chlorine and will fill approximately five (5) percent of the total storage volume. This solution will be held in the storage facility for not less than 6 hours.

- 2) After the initial 6-hour period, the storage facility shall be filled to the overflow level by flowing potable water into the highly chlorinated water. The chlorinated water shall be held in the storage facility for 24 hours and shall have a free chlorine residual of not less than 2 mg/L at the end of 24-hour period.
- 3) The actual volume of the initial 50 mg/L solution shall be adjusted as needed to provide the minimum 2 mg/L solution required at the end of the 24-hour period.

D. Handling of Disinfected Water

1. After the appropriate retention period for the selected method, the chlorine residual in the storage facility shall be reduced to a concentration appropriate for the distributions system (not more than 2 mg/L) by draining and refilling the storage facility with potable water or by a combination of additional holding time and blending with potable water having a low chlorine concentration.
2. All chlorinated water shall be disposed of in a procedure acceptable to the Georgia Environmental Protection Division. Heavily chlorinated water must not be disposed in a manner that will harm the environment. Neutralizing chemicals such as sulfur dioxide, sodium bisulfite, sodium sulfite or sodium thiosulfate can be used to neutralize the chlorine residual remaining in the water to be wasted.
- 3.

E. Sampling and Testing:

1. After the chlorine concentration in the storage facility has reached to a concentration appropriate for the distributions system (not more than 2 mg/L), water from the facility shall be sampled per AWWA C652 and tested for microbiological quality by a Georgia Environmental Protection Division approved laboratory in accordance with Georgia Rules for Safe Drinking Water, Chapter 391-3-5.
2. Samples shall be collected at multiple points with the storage facility, if possible.
3. For acceptance, the laboratory results for all samples must show:
 - a. Zero coliform bacteria present
 - b. Minimum 0.2 mg/L free chlorine residual
 - c. pH between 7.0 and 8.5
4. The water in the full storage facility should be tested to assure no offensive odor exist due to chlorine reactions or excess chlorine residual.
5. If all test for coliform organisms are negative, the storage facility may be placed in service.

F. Redisinfection:

1. If the initial disinfection fails to produce satisfactory bacteriological results or if the water quality is affected, the situation shall be evaluated by the Engineer. Repeat samples shall be

taken until two consecutive negative results are obtained at each sample point. When consecutive negative samples cannot be obtained, the Contractor shall disinfect the facility.

3.04 FIELD QUALITY CONTROL

A. Testing:

1. All samples shall be collected per AWWA standards.
2. Test for coliform bacteria shall be by a Georgia Environmental Protection Division approved laboratory
3. Chlorine measurements shall be with approved test kits or meters for free chlorine residual.

END OF SECTION

SECTION 33 31 13

SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Installation and Testing of gravity sanitary sewerage and plant drain piping.
- B. For installation of pressurized utility piping systems refer to Section 33 05 05, Buried Pipe Installation.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 03 30 00 - Cast-in-Place Concrete
 - 2. Section 31 23 33 - Trenching and Backfilling
 - 3. Section 33 05 05 – Buried Piping Installation
 - 4. Section 33 05 60 – Concrete Manholes and Vaults
 - 5. Section 33 05 19 - Ductile Iron Utility Pipe
 - 6. Section 33 05 31 – Thermoplastic Utility Pipe

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D3034 - Standard Specification for Type PSM PVC Sewer Pipe and Fittings
 - 2. ASTM F679 - Standard Specification for PVC Large-Diameter Gravity Sewer Pipe and Fittings
 - 3. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe
 - 4. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - 5. ASTM F1417 - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
 - 6. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure Test

B. American Water Works Association (AWWA):

1. AWWA C111 - Rubber-Gasket Joints
2. AWWA C600 - Installation of Ductile-Iron Water Mains

1.04 SUBMITTALS

A. Product Data

1. Ductile Iron Pipe to be submitted in accordance with Section 33 05 19, Ductile Iron Utility Pipe.
2. PVC Pipe shall be submitted in accordance with Section 33 05 31, Thermoplastic Utility Pipe

B. Shop Drawings:

1. Pipe Layout: Detailed plan showing inverts, joint types, fittings, manholes, and connections to structures for Gravity Sewerage and Plant Drain systems.
 - a. The Contractor shall furnish the Engineer with cut sheets for each line. Cut sheets shall show line number and in 50' increments invert, center line elevation and center line cut. Existing sewer lines and service lines shall be replaced to match existing line and grade unless otherwise shown on the Drawings.

C. Testing Procedures:

1. Provide details on low pressure testing protocol including proposed equipment.
2. Deflection testing plan for PVC pipes (ASTM D3034/F679).
3. Low-pressure air testing for gravity pipes (ASTM F1417
4. Test Reports: Submit test reports documenting test parameters and results for each test conducted.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Minimum 5-years experience in gravity sewer pipe installation
2. Successfully completed at least 3 similar projects in past 2 years
3. Work must be overseen by State of Georgia licensed Utility Foreman.

B. Regulatory Requirements:

1. Notify Georgia 811 "Call Before You Dig" or submit online dig ticket a minimum of 3 days prior to beginning excavations. Contractor shall adhere to all responses to the dig ticket.
2. Comply with OSHA requirements for trench safety
3. Follow local utility requirements

C. Inspection:

1. All work done and materials furnished shall be subject to inspection by the Engineer; all improper work shall be reconstructed, and all materials which do not conform to the requirements of the specifications shall be removed from the work upon notice being received from the Engineer of the rejection of those materials. The Engineer shall have the right to mark rejected materials, and to distinguish them as such.

PART 2 - PRODUCTS

2.01 PIPE MATERIALS

A. Ductile Iron Pipe: Refer to Section 33 05 19 Ductile Iron Utility Pipe.

1. Ductile iron pipe shall be used for sanitary sewer and drains at all aerial crossings, road crossings, shallow cuts and all other locations directed by the Drawings or Engineer

B. PVC Pipe: Refer to Section 33 05 31 Thermoplastic Utility Pipe

C. Warning Tape:

1. Minimum 6 inches wide, color-coded (blue for water, green for sewer, orange for process).
2. Marked with utility identification (e.g., "CAUTION: SEWER LINE BELOW").
3. Detectable metallic tape for PVC pipes

D. Tracer Wire

1. 12 AWG minimum, solid copper, direct burial-rated insulation
2. Connectors to be waterproof, direct burial rated, twist-on or split-bolt type

2.02 MANHOLES

A. Manhole shall be provided in accordance with Section 33 05 60, Concrete Manholes and Vaults

2.03 CLASSIFICATION OF BEDDING AND BACKFILL MATERIAL.

A. Materials for bedding and backfill shall be classified as follows:

1. Class I: Manufactured Aggregates (Crushed Stone) Angular $\frac{1}{4}$ " to $\frac{3}{4}$ " graded stone. Latest revision of ASTM C 33 - Gradation #67 (ASTM #67) or #57 (ASTM #57) are acceptable.
2. Class II: Coarse sands and gravels with maximum particle size of $\frac{3}{4}$ " including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry.
3. Class III: Fine sand and clayey (clay filled) gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures.
4. Class IV: Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits.

5. Class V: Fine-grained soil with high plasticity, organic soils, and soils containing frozen earth, debris, rocks larger than 1½" in diameter and other foreign materials. **Class V soils shall not be used for bedding or backfill unless directed otherwise by the Engineer**

2.04 TRENCH CONFIGURATIONS

A. Trench configurations shall be as noted in AWWA C151 as follows:

1. Type 1: Flat bottom trench of undisturbed earth with loose backfill
2. Type 2: Flat bottom trench of undisturbed earth with backfill lightly consolidated to the centerline of pipe
3. Type 3: Pipe bedded in minimum 4-inches of loose soil with backfill lightly consolidated to the top of pipe.
 - a. Loose soil is defined as native soil excavated from the trench, free of rocks, foreign materials, and frozen earth.
4. Type 4: Pipe bedded in sand, gravel, or crushed stone to a depth of 1/8 pipe diameter, 4-inch minimum, with backfill compacted to top of pipe. (Approximately 80% Standard Proctor)
 - a. Bedding material shall be Class I or Class II
5. Type 5: Pipe bedded to its centerline in compacted granular material, 4-in minimum under pipe. Compacted granular or select material to top of pipe. (Approximately 90% Standard Proctor)
 - a. Granular material shall be Class I bedding material
 - b. Select material is defined as native soil excavated from the trench, free of rocks, foreign materials, and frozen earth.

2.05 BACKFILL MATERIAL

- A. Select Backfill: Excavated soil free of rocks over 3 inches, organic material, or debris; suitable for compaction.
1. If excavated soil is not acceptable or available in sufficient quantities, Contractor shall provide select material acceptable to the Engineer.

2.06 TRENCHLESS PIPE MATERIAL

- A. Refer to Section 31 05 07, Trenchless Installation of Utility Pipe

2.07 CONCRETE ENCASEMENT:

1. Concrete shall be Class B, air entrained, or greater in accordance with Section 03 30 00
2. Placement of dry bag mixes will not be allowed.

PART 3 - EXECUTION

3.01 PREPARATION:

- A. Layout: The line and grade of the sewer and drain, and the positions of all manholes and other structures and other appurtenances shall be laid out by the Contractor.
 - 1. The Contractor shall locate existing manholes to determine alignment and grade. Alignment and grade shall match the existing.
 - 2. All lines and grades shall be subject to checking by the Engineer, but that checking shall in no way relieve the Contractor from responsibility for the correctness. The Contractor shall provide such field men and assistance as the Engineer may request and such hubs, stakes, spikes, nail and other fastenings as may be required in establishing and checking all controlling lines and grades

3.02 GENERAL:

- A. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
- B. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from Engineer before proceeding.
- C. Engineer will observe excavations and bedding prior to laying pipe by Contractor. Notify Engineer in advance of excavating, bedding, pipe laying, and backfilling operations.
- D. Excavation in excess of that required or shown, and that is not authorized by Engineer shall be filled at Contractor's expense with select fill furnished, placed, and compacted in accordance with Section 31 23 33, Trenching and Backfilling Utilities.
- E. Organization of Work:
 - 1. The Contractor shall so organize his work that backfilling and cleanup shall closely follow pipe laying operations and manhole construction.
 - 2. In general, not more than one block of a street or roadway shall be closed for construction at any one time. Before proceeding with trenching operations in a succeeding block, the preceding section shall be backfilled, cleanup completed and the street opened to traffic.
 - 3. For work outside the streets and roadways, backfilling and windrowing, in accordance with the provisions of Section 31 23 33, Trenching and Backfilling Utilities, shall be performed in such manner that not more than 500' of trench shall remain open at any one time.
 - 4. Failure on the part of the Contractor to comply with the above provisions in a reasonable manner, in the opinion of the Engineer, shall be sufficient cause for the Engineer to order a temporary shut-down of further trenching and pipe laying operations until the provisions have been met.
- F. Sequence of Work:
 - 1. Excavation, cleaning, laying, jointing, and backfilling shall be kept up as closely as is possible so-as-to progress the work in a uniform workmanlike manner.
 - 2. In no case shall pipe be left in the trench overnight without completing the jointing.

3. The completed pipe line shall not be left exposed in the trench unnecessarily; the Contractor shall backfill and compact the trench as soon as is possible after laying and jointing is completed.
4. Each day at the close of work and at all times when laying is not in progress, the exposed end of the pipe line in the trench shall be closed with an approved head or barrier of wood or metal. If at any time it becomes necessary to cover the end of an incomplete pipe line with backfill, the end of that pipe shall be closed with a mechanical joint plug.

3.03 TRENCH CONSTRUCTION

- A. Trench excavation shall be by open cut, unless noted otherwise on the drawings, in accordance with Section 31 23 33 Trenching and Backfilling.
- B. Trenches shall be dewatered as specified in Section 31 23 33, Trenching and Backfilling.
- C. Trenches shall be constructed of the configuration specified or otherwise indicated on the drawings.
 1. Alternate trench types may be required depending on the depth of bury, pipe class, and recommendations of the pipe manufacturer.
- D. Trenches shall be constructed to the line, grade and width shown on the drawings or otherwise specified.
- E. Trench depth shall be as noted on the drawing or as required for minimum cover plus any required bedding depth.
 1. Minimum cover over buried piping shall be 4 feet, unless otherwise shown or approved by Engineer.
 2. Where cover is less than 4 feet, ductile iron pipe must be used.
- F. Trench Width: Trench width shall be as required for placement, bedding, and backfill; placement of compaction equipment, and placement of shoring systems. In general, minimum trench widths shall be as follows:
 1. Minimum Trench Width for Pipe Excavations:
 - a. Ductile Iron Pipe: Pipe OD + 24 inches (12" each side)
 - b. PVC: Min. 18 inches or Pipe OD + 12 inches (whichever is greater).
 - c. The width of trenches where skeleton or solid sheeting is used may be increased if discussed with the Engineer but shall be not greater than that necessary to clear the walers when lowering pipe into the trench.
 - d. Narrower widths may be considered with prior approval from the Engineer.
 - e. The top portion of trenches may have sloping or vertical sides to any width which will not cause damage to adjoining structures, roadways, pavements, utilities and private property. For trenches not utilizing shoring or shields, the width of the lower portion of the trench, to a height of 2' above the top of the pipe, shall not exceed the trench specified trench width.

- G. The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of pipe.
- H. Bell holes shall be provided at each joint to ensure the pipe barrel will lie flat on the trench bottom. Bell holes shall be no larger than necessary to allow joint assembly.
- I. Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions but shall not include more than 400' of continuous open trench at any time

3.04 PLUGS:

- A. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
- B. Install standard plugs in bells at dead ends. Cap spigot and plain ends.
- C. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
- D. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to Engineer.

3.05 SEPARATION OF SEWERS AND POTABLE WATER PIPING:

A. Horizontal Separation

- 1. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
- 2. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undisturbed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
- 3. Exception:
 - a. Where it is not possible to provide minimum horizontal separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test water main and sewer as specified in this Section prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.

B. Vertical Separation

- 1. Provide minimum vertical distance of 18 inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
- 2. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.

3. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
4. Exceptions:
 - a. Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
 - b. Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

3.06 PIPE BEDDING AND HAUNCHING:

- A. Bed pipe as specified and in accordance with the details on the Drawings or as noted in these specifications.
- B. PVC Pipe:
 1. PVC pipe shall be laid as specified using the following classes of bedding required for the various types of soils and conditions encountered. Bedding for PVC pipe shall be in accordance with ASTM D 2321, as amended to date, the manufacturer's recommendations and these Specifications.
 2. Bedding Material: Class I materials shall be used for bedding and haunching in all conditions. Class II, III, IV and V materials will not be permitted for bedding and haunching under any condition.
 3. Depth of Bedding: Bedding material shall be used to provide uniform longitudinal support for the pipe. Trench shall be undercut to allow for a minimum of 6" of bedding material.
 4. Bell holes shall be excavated in the bedding material to allow for unobstructed assembly of the joint, but care shall be taken to assure that bell hole is no larger than necessary to accomplish proper joint assembly. After joint assembly, material shall be placed underground around the entire length of pipe and compacted. Compaction to the spring line of the pipe shall be of the same material used in the bedding.
 5. Backfill with Class I, II, III or IV material shall then be carried to a point 6" above the top of pipe, using hand tools for tamping, Class IV material will not be allowed in a wet ditch. If the remaining backfill material contains large particles which could damage the pipe from impact during placement the initial backfill shall be increased to 12" above the top of the pipe. Puddling will not be allowed as a method of compaction. The remaining backfill shall be as specified in "Selected Backfill" and "General Backfill" paragraphs of these Specifications. Pipe shall have at least 30" of cover before wheel loading and at least 48" of cover before using heavy-duty tamping equipment such as a hydrohammer.

3.07 SEWER PIPE INSTALLATION

- A. Force Mains: Refer to Section 33 05 05, Buried Pipe Installation
- B. Gravity Sewers and Drains

1. General:
 - a. Sewerage and drain pipe shall be of the types noted on the drawings. Piping systems not specifically scheduled or otherwise specified shall be provided as ductile iron.
 - b. Ductile iron pipe shall be used for sanitary sewer at all aerial crossings, road crossings, shallow cuts and all locations directed by the Drawings or Engineer.
2. Handling:
 - a. Proper and suitable tools and equipment, for the safe and convenient handling and laying of pipe, shall be used; great care shall be taken to prevent the pipe and coatings from being damaged.
 - b. Ductile iron pipe and fittings shall be carefully examined for cracks, broken lining or other defects.
 - c. PVC pipe shall be carefully examined to ensure that pipe is homogenous throughout, free from cracks, nicks, gouges, severe scratches, etc.
 - d. No pipe or other castings shall be laid which are known to be defective. If pipe and other castings are discovered to be cracked, broken or defective after being laid, it shall be removed and replaced with sound material, at no additional expense to the Owner.
 - e. All pipe and fittings shall be thoroughly cleaned before being laid, and shall be kept clean until accepted in the complete work
3. Cleaning:
 - a. The Contractor shall clean each joint of pipe while it is suspended before it is lowered into the trench.
 - b. The Contractor shall keep exposed ends of the pipe properly plugged during laying to prevent dirt and other materials from entering the line, and shall, before the system is accepted, thoroughly clean all lines.
4. Laying Gravity Sewer Pipe:
 - a. All sewer pipe shall be laid upgrade; the spigots shall point downgrade.
 - b. Where cover is less than 4 feet, ductile iron pipe must be used.
5. Ductile Iron Pipe Installation:
 - a. Cutting Ductile Iron Pipe:
 - 1) Cutting shall be done by skilled workmen, using an abrasive wheel cutter. Use of oxyacetylene torch will not be permitted.
 - 2) The plain end shall be beveled and inspected, any sharp edges, which might damage the gasket, shall be removed by means of a file or power grinder. Pipe that is cut in the field must be ground and beveled before assembly

b. Jointing Ductile Iron Pipe:

- 1) Buried pipe shall have push-on joints and mechanical joint fittings. Restrained joints shall be provided where indicated on the drawings.
- 2) Jointing shall be as recommended by the pipe manufacturer for the specified joint type.
- 3) Gaskets and bell sockets shall be cleaned and lubricated prior to jointing.
- 4) During assembly of the pipe, the joint must be kept straight while pushing. Pipe may be deflected if desired but only after the assembly is completed.

c. Laying Conditions:

- 1) Unless otherwise detailed on the drawings, trench configurations shall be Type IV or V with a minimum of 6" compacted Class I granular material under the pipe .

6. PVC Pipe Installation

a. Cutting PVC Pipe

- 1) Cutting shall be done by skilled workmen using a hacksaw, a fine toothed hand saw or a power saw with a steel blade or abrasive discs.
- 2) After cutting is complete, pipe shall be beveled with a beveling tool or similar equipment.
- 3) Before jointing section of pipe reference mark must be located on spigot end to insure proper jointing

b. Assembly of Gasketed Joint

- 1) The assembly of the gasketed joint shall be performed as recommended by the pipe manufacturer.
- 2) The elastomeric gaskets may be supplied separately in cartons or pre-positioned in the bell joint or coupling at the factory. When gaskets are color coded, the Contractor shall consult the pipe manufacturer or his literature for the significance.
- 3) The gasket, bell or coupling interior, especially the groove area (except when gasket is permanently installed) and the spigot area shall be cleaned with a cloth, brush or paper towel to remove any dirt or foreign material before the assembling.
- 4) The gasket pipe spigot bevel, gasket groove, and sealing surfaces shall be inspected for damage or deformation. When gaskets are separate, only gaskets, which are designed for and supplied with the pipe shall be used. They shall be inserted as recommended by the manufacturer.
- 5) Lubricant used shall be supplied by the pipe manufacturer and shall be applied as specified by the pipe manufacturer.

c. Assembly of Pipe Joints:

- 1) After lubrication, the pipe is ready to be joined. Good alignment of the pipe is essential for ease of assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or “stab” the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion. The pipe should be inserted up to this line.
- 2) If undue resistance to insertion of the pipe end is encountered or the reference mark does not position properly, the joint shall be disassembled and the position of the gasket checked. If it is twisted or pushed out of its seat (“fishmouthed”), the Contractor shall inspect components, repair or replace damaged items, clean the components and repeat the assembly steps. Both pipe lengths must be concentric alignment. If the gasket was not out of position, the Contractor shall verify proper location of the reference mark. The reference mark shall be relocated if it is out of position.

d. Laying Conditions:

- 1) Earth Excavations:
 - a) Unless otherwise detailed on the drawings, trench configurations shall be Type I, II, III, IV, or V as recommended by the Pipe Manufacturer for the class of pipe and bury depth.
 - b) Pipes shall not be laid on loose rock or other hard materials.
- 2) Rock Excavations:
 - a) Unless otherwise detailed on the drawings, trench configurations shall be Type IV or V with a minimum of 6” compacted Class I granular material under the pipe and as recommended by the Pipe Manufacturer for the class of pipe and bury depth.

3.08 TRACER WIRE AND WARNING TAPE

- A. **Tracer Wire:** Before backfilling, tracer wire shall be installed longitudinally along the top of the pipe line. Locating wire shall be wrapped around the pipe at every 100 linear feet. and brought to within 24" of the finished grade. Provide tracer wire connector stations every 1,000 feet in meter vault or pressure treated 4x4 post (in areas that are not regularly maintained).
 1. Tracer wire is required for all Thermoplastic Piping
 2. Tracer wire is required for all Ductile Iron Pipe buried greater than 8'.
- B. **Warning Tape:** During backfill, install warning tape a minimum of 12 inches below the surface and approximately 24-36 inches above the pipe.
 1. Warning Tape is required for all piping systems.

3.09 BACKFILLING

- A. All trenches shall be backfilled immediately after pipes are laid therein, and joints have been inspected by the Engineer, unless other protection of the pipe line is directed.
- B. When testing for leaks in open trenches, backfilling shall not be done until after all testing has been completed and all leaks eliminated.
- C. Selected Backfilling:
 - 1. Selected backfill material shall consist of finely divided earthstone dust, sand, crushed stone, or other approved material carefully placed about the pipe and up to a height of at least 12" above the top of the pipe barrel, and in uniform layers not exceeding 6" in thickness, each layer thoroughly compacted with proper hand tools in a manner which will not disturb and/or injure the pipe.
 - 2. Backfilling shall be carried on simultaneously on both sides of the pipe and in a manner which will prevent injurious side pressures.
 - 3. If suitable select materials are not available from the trench excavation, the Contractor will be required to obtain the select materials elsewhere.
- D. General Backfilling:
 - 1. After selected backfill material has been placed and tamped, the remainder of the trench may be backfilled with general excavated material, provided such material does not contain more than $\frac{1}{3}$ broken rock of which no single stone or boulder shall be larger than can easily be removed with a hand shovel.
 - 2. Backfill material shall be placed in uniform layers not exceeding 12" in thickness; each layer shall be thoroughly compacted with heavy-duty power tamping tools of the full satisfaction of the Engineer. Wherever the trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and finally made to conform to the surface of the ground.
 - 3. Backfilling shall be carefully performed, and the original surface restored to the full satisfaction of the Engineer.
 - 4. Surplus material shall be disposed of by the Contractor.
 - 5. Street and Road Right of Way, Yards and Other Traveled Areas:
 - a. In streets and road right of ways, yards and other traveled areas open to vehicular or pedestrian travel the ditch shall be backfilled and each layer shall be tamped to a density equivalent to at least 95% of the Standard Proctor maximum dry density in accordance with ASTM D 698, as amended to date.
 - b. Backfill material shall be placed in uniform layers not exceeding 6" in thickness with each layer thoroughly compacted with heavy duty tampers ("Whacker" or equal) to a height of at least 36" or 48" above the top of the pipe barrel.
 - c. The remainder of the ditch may be backfilled and tamped in the same manner or if the Contractor so elects he may place backfill in layers not exceeding 12" and use wheel loading or heavy duty power tamping equipment ("Hydro-Hammer" or equal). Pipe shall have at least 36" of cover before wheel loading and at least 48" of cover before using heavy duty tamping equipment ("Hydro-Hammer" or equal).

d. Areas Requiring Pavement Replacement:

- 1) Mechanical tamping will be required of all backfilling of excavated portions.
- 2) After backfilling and tamping is completed the top 6" of the ditch shall be backfilled with Compacted Crushed Stone, ASTM C33 Gradation #67 or #57, as amended to date, with sufficient fines for compaction. Further compaction shall be accomplished by leaving the backfilled trench open to traffic while maintaining the surface with stone. Settlement in trenches shall be refilled with stone and such maintenance shall continue until replacement of pavement is authorized by the Engineer.
- 3) The cost of the 6" of stone and any additional stone used shall be included in unit price bid for replacing pavement

e. Other Areas:

- 1) In other areas, including woodlands, fields, pastures and areas not open to vehicular travel and the remainder of the ditch, may be backfilled by placing fill in the ditch and "walking-in" the fill with wheel loaded equipment.
- 2) Backfill material may be windrowed and maintained in a suitable manner so as to concentrate and pond rainfall runoff over the trench. After sufficient settlement has been obtained, the Contractor shall complete surface dressing, remove surplus material and clean up in accordance with these Specifications.
- 3) Wherever trenches have not been properly filled or if settlement occurs, they shall be refilled, smoothed off and finally made to conform to the surface of the ground. Backfilling shall be carefully performed and the original surface restored as specified herein. Surplus material shall be disposed of by the Contractor

3.10 CONCRETE PIPE ENCASEMENT:

- A. Where shown, and where otherwise directed by the Engineer, the pipe shall be completely encased in concrete.
 1. Unless noted otherwise on the drawings, all piping below structural slabs and footings shall be encased in concrete.
- B. The trench shall first be excavated not less than 6" below the bell of the pipe and the pipe laid to line and grade on concrete blocking.
- C. Concrete shall then be poured to the full width of the trench, but in no case less than 6" from the pipe bell on either side of the pipe, and to a height of not less than 6" above the top of the pipe bell.
- D. No backfill material shall be placed in the trench for a period of at least 24 hours after the concrete encasement has been poured.

3.11 INSTALLATION BY BORING AND JACKING

- A. Where called for on the Drawings, pipes shall be installed by the boring and jacking method in accordance with Section 33 05 07, Trenchless Installation of Utility Piping.

3.12 POLYETHYLENE ENCASEMENT OF DUCTILE IRON PIPE

- A. Polyethylene encasement of ductile iron shall be installed where noted on the drawings
- B. Install in accordance with Specification 33 05 19, Ductile Iron Utility Pipe:

3.13 JOINTING DISSIMILAR PIPE

- A. Dissimilar pipes shall be joined together using flexible couplings as manufactured by Fernco, Mission, or Equal.
- B. Concrete collars will be permitted only if flexible couplings are not available in sizes needed. Concrete collar shall be constructed of Class 'A' concrete, per Specification 03 33 00 and shall be poured to completely and securely encase the entire joint. The collar shall be formed as shown on the Drawings or if no detail is shown, the collar shall be constructed as directed by the Engineer. The inside of the pipe shall be free of foreign material to the satisfaction of the Engineer.

3.14 CONNECTIONS TO STRUCTURES:

- A. At all structures, including manholes, provide a flexible joint for all pipe not more than 24" from the face of the structure. It shall be the responsibility of the Contractor to submit details of the proposed connection to the Engineer for review. Unacceptable connections will be subject to removal and replacement by an acceptable flexible joint.

3.15 CONNECTIONS TO EXISTING MANHOLES

- A. At locations where new sewers are shown to be connected to existing manholes the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations.
- B. The work shall consist of coring the opening in the manhole wall, installing a flexible rubber boot, inserting the new pipe to the elevation shown, filling the space in the wall around the pipe with mortar, and constructing and remodeling manhole inverts.
- C. The bypassing of raw wastewater onto the ground or into a receiving stream is prohibited.
- D. High-early strength cement shall be used for mortar in order that proper channels may be formed in manhole bottoms with a minimum interruption of service to the existing sewer.

3.16 CONNECTIONS TO EXISTING SEWERS

- A. At locations where new sewers are shown to be connected to existing sewers at a new manhole, the Contractor shall first expose the existing sewer and remove all soil to a minimum of 6" below the existing pipe. Support shall be provided as required to prevent the existing sewer from sagging.
- B. The new precast doghouse manhole section should be placed over the existing sewer and the invert and bench subsequently poured with Class 'A' concrete.
- C. The ends of the manhole should be sealed watertight with concrete or hydraulic cement.
- D. Under special conditions, the Contractor may temporarily block and/or divert sewage flows to facilitate construction operations with prior approval from the Engineer. Actual physical connection of the sewers will be made at a later date as directed by the Engineer.

3.17 TESTING AND CLEANING:

- A. Before acceptance of any sewer or drains, lines shall be cleaned and tested in accordance with these Specifications.
- B. Where any obstruction is met, the Contractor will be required to clean the sewers by means of rods, swabs, or other instruments. Lines and manholes shall be clean before final inspection.
- C. Pipe lines shall be straight and shown a uniform grade between manholes. The Contractor shall be required to correct any variations therefrom which may be disclosed during the inspection
- D. Deflection Testing:
 - 1. The maximum deflection in the installed pipe line shall not exceed 5% of the pipes original internal diameter. The sewer alignment shall be checked by a visual inspection including either laser or lamping alignment. Deflection testing will be required using either a deflectometer or a "GO-NO-GO" mandrel. The Engineer shall randomly select portions of the project to be deflection tested after a period of 30 days has elapsed after backfilling has occurred. Such portions shall consist of not less than 5% of the total reaches (reach being length of pipe between 2 manholes) in the project (excluding house leads).
 - 2. The Contractor when using a mandrel shall use a pull line and a retrieve line. The pull line shall be blown in the line by means of air or water. The mandrel shall be placed in the pipe and be pulled up or down the pipe to the next manhole or defect. Testing shall be done in accordance with ASTM D 3034 Standards.
 - 3. Where deflection is found to be in excess of 5% of the original pipe diameter, the Contractor shall excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. The line shall then be retested for deflection. However, should after the initial testing the deflection pipe fail to return to the original size (inside diameter) the line shall be replaced.
 - 4. In the event that deflection occurs beyond the 5% limit in any section of 5% or more of the reaches tested, the entire system shall be tested.
- E. Leakage/ Low Pressure Air
 - 1. All new or rehabilitated sewer lines and drains, including service lines, shall be tested for leakage, in the presence of the Engineer or his representative, before being placed into service. Tests shall be conducted by one or a combination of the following three methods:
 - 2. Low pressure air testing shall be performed in accordance with ASTM F1417 or UNI-B-6-90, as amended to date.
 - 3. Prior to air testing the section of sewer between manholes shall be thoroughly cleaned and wetted.
 - 4. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (25' or less) using air-lock balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0-psi. After this pressure is reached and the pressure allowed to stabilize (approximately 2 to 5 minutes), the pressure may be reduced to 3.5-psi before starting the tests. If a 1.0 psi drop does not occur within the test time, then the line

has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make necessary repairs and retest the line.

5. Minimum test time for various pipe sizes, in accordance with Uni-Bell PVC Pipe Assoc. UNI-B-6-90, as amended to date, is as follows:

***Specification Time required for a 1.0 PSIG Pressure Drop
for Size and Length of Pipe Indicated for Q = 0.0015***

<i>Pipe Diameter</i>	<i>Minimum Time (minutes: seconds)</i>	<i>Length for Minimum Time</i>	<i>Time for Longer Length (second)</i>
4"	3:46	597'	0.380
6"	5:40	398'	0.854
8"	7:34	298'	1.520
10"	9:26	239'	2.374
12"	11:20	199'	3.418
15"	14:10	159'	5.342
18"	17:00	133'	7.692
21"	19:50	114'	10.470
24"	22:40	99'	13.674

6. Required test equipment includes air-lock balls, braces, air hose, air source, timer, rotometer as applicable, cut-off valves, pressure reducing valve, 0-15 pressure gauge, 0-5 pressure gauge with gradations in 0.1 psi and accuracy of ± 2 percent.
7. The Contractor shall keep records of all tests made. Copy of such records will be given to the Engineer or the Owner. Such records shall show date, line number and stations, operator and such other pertinent information as required by the Engineer.
8. The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.
9. Repairs: All visible leaks shall be repaired regardless of whether the air test is within allowable limits. No sewer will be accepted until leakage tests demonstrate compliance with the leakage test method.

F. Video Inspection:

1. All sewer lines and manholes shall be televised and recorded.
2. The video shall be of a quality that any and all deficiencies such as cracked pipes, rolled gaskets, leaking joints, deviations from line and grade (pipe line shall show more than three-

quarters of the opening at the opposite end of the pipe line), pipe deformations, etc., can be easily identified and located.

3. The video shall contain all pertinent information including but not limited to location, line size, material, starting manhole, direction headed, distance from starting manhole to service connection and length of line.

3.18 FIELD QUALITY CONTROL

A. Inspection

1. Contractor shall not backfill pipe lines until the Engineer has inspected the following:
 - a. Bedding prior to pipe installation
 - b. Joint assembly
 - c. Polyethylene encasement installation when applicable
 - d. Warning tape/tracer wire
2. During backfill operations compaction test shall be performed by third party testing agency where required in these specifications.

3.19 PROTECTION

- A. Installed pipe shall be protected from traffic loads, construction equipment, flooding, and debris.
- B. Damaged pipe shall be repaired immediately including:
 1. Replacing damaged pipe sections
 2. Repairing damaged coatings
 3. Replacing damaged polyethylene encasement
- C. Any subsequent settlement of backfill or pavement over trenches shall be replaced by the Contractor and the surfaces brought to grade.

3.20 CLEAN UP

- A. Before the work shall be considered complete, all material not used, and rubbish of every character, must be removed from the streets and placed at some point to be designated by the Owner
- B. All streets, sidewalks, curbs, fences and other private or public facilities and structures disturbed must be essentially in as good condition as existed before the work was done.

3.21 INSTALLATION BY BORING AND JACKING

- A. Where called for on the Drawings, pipes shall be installed by the boring and jacking method in accordance with Section 33 05 07, Trenchless Installation of Utility Piping.

END OF SECTION

SECTION 33 42 00

STORMWATER CONVEYANCE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Furnishing and installing stormwater conveyance systems, including reinforced concrete pipe (RCP), high-density polyethylene (HDPE) pipe, corrugated metal pipe (CMP), fittings, joints, and appurtenances for managing stormwater runoff.

B. RELATED DOCUMENTS

- C. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

D. Related Specifications

1. Section 31 20 00 – Earth Moving
2. Section 31 23 33 - Trenching and Backfilling
3. Section 33 05 05 - Buried Pipe Installation
4. Section 22 05 60 – Concrete Manholes and Vaults

1.02 REFERENCES

A. ASTM International:

1. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
2. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
3. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
4. ASTM F667 - Standard Specification for 3 through 24 in. Corrugated Polyethylene Pipe and Fittings
5. ASTM A760 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drain

B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe (3-10 inch)

2. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12 to 60 in. Diameter
 3. AASHTO M36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
- C. American Concrete Pipe Association (ACPA)
1. ACPA - Load and Resistance Factor Design (LRFD) Fill Height Tables
 2. ACPA – Concrete Pipe Design Manual
- 1.03 SUBMITTALS
- A. Product Data:
1. Cutsheets and catalog information for pipe materials including class, gaskets, coatings, dimensions, stiffness ratings, and corrosion resistance..
- B. Installation Instructions:
1. Submit manufacturer's procedures for handling, joining, and bedding Quality Assurance/Control Submittals:
- 1.04 QUALITY ASSURANCE
- A. Manufacturer Qualifications:
1. The manufacturer must have an ISO 9001 certified facility with at least five years of experience in pipe manufacturing.
- B. Pipe Testing:
1. All pipe shall be tested by an approved testing laboratory. It shall be stamped with the laboratory's special stamp. Each joint of pipe so stamped shall indicate the laboratory's certification that it was accepted in accordance with requirements of these specifications for pipe quality.
- C. Installer Qualifications:
1. The installer must have at least 5 years of experience in utility piping installation and demonstrated expertise with similar systems.
 2. Installer must be a licensed Utility Contractor and all work shall be supervised by a licensed Utility Foreman.
- 1.05 DELIVERY, STORAGE, AND HANDLING
- A. Ship pipe and fittings in bundles or cradles, labeled with size, material, and standard (e.g., ASTM C76).
- B. Store pipe as recommended by the manufacturer.
- C. Use slings or padded equipment; reject pipe with cracks >0.01 inch (RCP), damage >10% wall thickness (HDPE), or dents >1/8 inch (CMP)

1.06 EXISTING CONDITIONS

- A. Verify field measurements prior to installation.

PART 2 - PRODUCTS

2.01 REINFORCED CONCRETE PIPE

- A. General: Unless noted otherwise on the drawings, RCP shall be used for all permanent storm drains.
- B. Material:
 - 1. Standard: ASTM C76, Class III minimum
 - a. Class IV or V may be required depending on bedding type and fill height in accordance with the Load and Resistance Factor Design (LRFD) Fill Height Tables as published by American Concrete Pipe Association.
 - 2. Cement: Type II unless otherwise approved by the Engineer.
 - 3. Sizes: 12-inch to 96-inch diameter, as shown on drawings
 - 4. Wall Thickness: Per ASTM C76, Table II, Wall B
 - 5. Reinforcement: Circumferential steel per ASTM A615, designed for HS-20 loading
- C. Joints
 - 1. Bell-and-spigot or tongue-and-groove, with rubber gaskets per ASTM C443, watertight to 13 psi.
- D. Properties
 - 1. Compressive strength 4,000 psi minimum at 28 days
- E. Fittings: ASTM C76 or C443, matching pipe class and joint type.

2.02 HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

- A. General: Provide HDPE Pipe where noted on the drawings for stormwater conveyance.
- B. Material
 - 1. Standard: AASHTO M252 (3-10 inch) or M294 (12-60 inch), Type S (smooth interior, corrugated exterior).
 - 2. Sizes: 4-inch to 60-inch diameter, as shown on drawings (e.g., 18-inch typical).
 - 3. Resin: Virgin PE4710, UV-resistant per AASHTO.
- C. Properties:

1. Minimum Pipe Stiffness: 40 psi at 5% deflection per ASTM D2412 for 12-inch, decreasing per AASHTO M294 for larger sizes.
 2. Manning's n: 0.010-0.012 for smooth interior.
- D. Joints: Bell-and-spigot or snap-on couplings, watertight to 10 psi with gaskets per ASTM F477; welded joints if specified for high watertightness.
- E. Fittings: AASHTO M294, matching pipe and joint type.
- 2.03 CORRUGATED METAL PIPE (CMP)
- A. General: Provide CMP Pipe where noted on the drawings for stormwater conveyance.
- B. Material
1. Standard: STM A760 or AASHTO M36, galvanized steel or aluminized Type 2.
 2. Thickness:
 - a. 24" diameter and smaller: 16 gauge
 - b. 30" to 36" diameter: 14 gauge
 - c. 43" to 54" diameter: 12 gauge
 - d. 60" to 72" diameter: 10 gauge
 - e. 78" to 84" diameter: 8 gauge
 3. Sizes: As shown on drawings.
 4. Coating: Fully bituminous coated with a paved invert for at least 25% of the circumference. Bituminous coating shall be a minimum of 0.05" measured to the crest of corrugations.
- C. Corrugations: 2 $\frac{2}{3}$ " x $\frac{1}{2}$ ".
- D. Properties:
1. Minimum Strength: Per ASTM A760 for HS-20 loading.
 2. Corrugation: 2-2/3 inch x 1/2 inch or 3 inch x 1 inch, as specified.
- E. Joints: Band couplings with gaskets, watertight to 5 psi per ASTM A798, unless non-watertight specified.
- F. Fittings: ASTM A760, matching pipe gauge/coating, and joint type.
- 2.04 ACCESSORIES
- A. End Sections: Provide headwalls or flare ends as noted on the drawings.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Inspect pipe for damage.
- B. Clean bell and spigot ends before jointing.

3.02 TRENCHING

- A. Pipe trenches shall be excavated and backfilled in accordance with Section 31 23 33, Trenching and Backfilling Utilities.
- B. Trench excavation shall not advance more than 200 feet ahead of pipe installation without prior approval. The bottom of all trenches shall be smooth and flat and with backfill material affording full bearing of the pipe barrel.

C. BEDDING

- 1. Trenches shall have been excavated accurately to plan grade to provide a uniform and stable foundation.
- 2. A maximum overcut of 6 inch shall be allowed.
- 3. Materials of poor or non-uniform bearing capacity shall be removed and replaced with suitable material.
- 4. Rock shall be excavated to a depth of 6 inches below plan grade and suitable bedding placed.
- 5. For HDPE and CMP, a uniform blanket of graded aggregate material shall cover the bedding to a depth sufficient to allow the corrugations to become filled with material.
- 6. Bedding or shaping shall be wide enough to permit efficient compaction of the remaining backfill under the haunches of the structure, but not so wide as to interfere with bolting procedures

3.03 BACKFILL

- A. After pipe is laid in the prepared trench bottom, bedding as previously specified shall be placed and compacted under the pipe haunches to the center of the pipe and carefully compacted by hand.
- B. Only sufficient material to backfill to the centerline of the pipe shall be placed in the ditch and compacted until satisfactory compaction has been attained.
- C. When haunch compaction is attained, the contractor shall begin backfill of the trench, placing material symmetrically so as to prevent eccentric loading or wedge action against the pipe.
 - 1. On RCP placed within the right of way, Class I, II or III backfill shall be placed in lifts of no more than 8 inches loose and compacted by mechanical tampers to 100% maximum dry density, standard proctor.
 - 2. HDPE shall be backfilled with graded aggregate material meeting GDOT specifications with the following restrictions:
 - a. 20 foot maximum fill height for HDPE

- D. No material which has previously disapproved or found unsuitable, or is wet or frozen or contains mulch or other organic perishable material of any description, large stones, blasted rock, broken concrete or pavement, or other hard materials having any dimensions greater than 2 inches; Clods of earth or dirt larger in any dimension greater than 2 inches, debris or earth with an exceptionally high void or clay content shall be placed as backfill in any trench.

3.04 PIPE LAYING

- A. Install piping beginning at low point, true to grades and alignment with unbroken continuity of invert. Place bell ends of piping facing upstream.
- B. Install gaskets, seals, sleeves, and couplings according to the manufacturer's written instructions for use of lubricants, cements and other installation requirements.
- C. Use proper size increaser, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

END OF SECTION

SECTION 40 05 00

COMMON WORK RESULTS FOR PROCESS PIPING INTERCONNECTIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section covers common requirements for interconnections between process piping systems.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 33 05 05 – Buried Pipe Installation
 - 3. Section 33-13-00 – Disinfection of Water Systems
 - 4. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
 - 5. Section 40 05 19 – Ductile Iron Process Piping
 - 6. Section 40 05 23 – Stainless Steel Process Pipe and Tubing
 - 7. Section 40 05 31 – Thermoplastic Process Pipe
 - 8. Section 40 05 51 – Common Requirements for Process Valves
 - 9. Section 40 05 57 – Actuators for Process Valves and Gates

1.03 SUBMITTALS

- A. Layout Drawings: The Contractor shall furnish pipe fabrication details and dimensional layouts for all piping systems for checking and review by the Engineer in accordance with Section 01 33 00. Each joint of pipe and fittings shall be marked and dimensioned to ensure accuracy of the layout. Installation shall not commence until those drawings have been ~~been approved~~ reviewed and stamped by the Engineer
- B. Product Data: Submit product data for all piping materials in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. End caps shall be factory-applied to pipes to keep debris, dust, and moisture from entering and potentially contaminating or damaging the pipe interior.

2. Label each pipe section with unique identifiers to ensure proper traceability and installation.
3. Protect flanged ends during shipping from bending, cracking, or distortion.
4. Provide coating protection during shipping.

B. Storage:

1. Store materials according to manufacturer instructions.
2. When possible, store pipes indoors to protect them from rain, direct sunlight, and temperature fluctuations.
3. If indoor storage isn't possible, use tarps, covers, or other protective materials to shield pipes from moisture, dust, and harsh weather.
4. Position pipes on stable, non-reactive blocking materials that prevent direct contact with the ground.

C. Protection:

1. Protect materials from moisture and dust by storing them in clean, dry locations remote from construction operations areas.
2. Protect piping and appurtenances by storing off ground.
3. Provide additional protection according to manufacturer instructions.

D. Handling:

1. Pipe and fittings lined with cement, ceramic epoxy, or fusion bonded epoxy linings should be handled with rubber-covered hooks or other type equipment to prevent damage to the lining.
2. Forklift arms or hooks should not be inserted into open ends. Hooks, forks, chains, straps, and other lifting devices must be rubber-coated and used only on the exterior of fittings to prevent damage to the coating.
3. If the coating becomes damaged, notify the pipe and coating manufacturers to determine whether repair or re-coating is needed. Perform repairs using the manufacturer's recommended procedures and materials, subject to approval by the ENGINEER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Pipe runs shall be installed parallel with or at right angles to walls, ceilings, and equipment. 45-degree fittings and angled runs shall be avoided to the extent possible.

- B. Piping shall be arranged and installed neatly, satisfying the service requirements and ensuring accessibility to the machinery and equipment it serves.
 - C. Valves shall be installed in accessible locations, allowing operation by a person standing on the floor.
 - 1. Valve actuators shall be oriented for ease of accessibility and operation.
 - D. Piping requiring drainage of moisture shall be installed with the necessary slope in the proper direction for gravity drainage, minimizing interference with foot traffic.
 - E. Parallel runs of piping shall be installed with equidistant spacing between the pipes and neatly grouped. Grouping shall be arranged to avoid crossovers, except for branch connections.
 - F. Valves with a bury depth greater than 4 feet shall be supplied with valve nut extension stem.
 - G. All piping and appurtenances shall be properly supported by a system of hangers, pipe stands, saddles, base ells and concrete piers as required. Concrete insets, bolts, anchors, etc., shall be placed in the forms before placing concrete.
 - H. Drip piping, $\frac{3}{4}$ " in size, shall be provided for all pumps with crosses and plugs at all changes of direction. Piping shall be run to nearest drain in a manner not to constitute a hazard to floor traffic. Contractor shall furnish plug valve or stop cock bleeds for high points in piping for all pumping units.
- 3.02 PRESSURE AND LEAKAGE TESTING
- A. Buried piping shall be pressure tested per Section 33 05 05.
 - B. Above grade piping shall be tested as required for buried pipe in Section 33 05 05 or visually inspected for leaks as directed by the ENGINEER.
 - C. Repair any leaks and re-test until interconnections pass.
- 3.03 DISINFECTION OF WATER POTABLE WATER PIPING
- A. Potable water piping shall be disinfected in accordance with Section 33 13 00, Disinfection of Water Systems.

END OF SECTION

SECTION 40 05 06

COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. This section covers the labor, equipment, and materials needed to supply and install pipe couplings and expansion joints. This includes grooved couplings, flanged adapters, expansion couplings, expansion joints, metal flexible pipe connectors as indicated in the Drawings, specified in this document, or required for proper installation of piping and equipment.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 09 91 00 – Painting
 - 3. Section 40 05 19 – Ductile Iron Process Piping
 - 4. Section 40 05 51 - Common Requirements for Process Valves

1.03 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C200 - Steel Water Pipe Specifications
 - 2. AWWA C219 - Bolted Sleeve-Type Couplings for Plain-End Pipe
 - 3. AWWA C606 - Grooved and Shouldered Joints
- B. ASME Standards:
 - 1. ASME B31.3 - Process Piping
- C. ASTM International:
 - 1. ASTM A536 - Standard Specification for Ductile Iron Castings
 - 2. ASTM B16.1 - Cast Iron Pipe Flanges and Flanged Fittings
- D. NSF International
 - 1. NSF 61 - Drinking Water System Components

1.04 SUBMITTALS

- A. Submit shop drawings of pipe couplings and adaptors in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
 - B. Product Data:
 - 1. Cutsheets and catalog information for the following: coupling and adaptor materials, pressure classes, details and pressure ratings, lining and coating systems with chemical resistance data.
- 1.05 WARRANTY
- A. Provide a warranty against defective materials and workmanship in accordance with the manufacturer's standard literature.
- 1.06 REGULATORY REQUIREMENTS
- A. All products or materials that will come into contact with drinking water must be NSF/ANSI standard 61 certified.

PART 2 - PRODUCTS

2.01 FLEXIBLE COUPLINGS

- A. The pipe coupling shall be of a gasketed, sleeve-type design with diameter to properly fit the pipe conforming to AWWA C219. Each coupling shall consist of one (1) steel middle ring, two (2) steel followers, two (2) rubber-compounded wedge section gaskets and sufficient track-head steel bolts to properly compress the gaskets.
 - 1. The middle ring, inside and out, and followers shall be coated with thermosetting, fusion-bonded epoxy coating material that provides disbandment resistance in cathodically-protected systems and resistance to soil stresses.
 - 2. The minimum working pressure of the coupling shall match the installed piping system.
 - 3. Gaskets shall be EPDM suitable for the service as recommended by the manufacturer.
 - 4. Bolts and nuts shall be corrosion-resistant, high-strength alloy steel. For buried or submerged applications, provide stainless steel bolts.
 - 5. Pipe ends shall be prepared per manufacturer requirements.
 - 6. Couplings shall be Dresser Style 38, Smith-Blair 411, or equal.

2.02 RESTRAINED FLANGE ADAPTERS

- A. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
- B. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to ensure proper initial set of gripping wedges.

- C. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
- D. For PVC pipe, the flange adapter will have a pressure rating equal to the pipe.
- E. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.
- F. The flange adapter shall be the Series 2100 Megaflange adapter, as produced by EBAA Iron, Inc., Style 911 by Smith Blair or equal.

2.03 DISMANTLING JOINTS

- A. Furnish and install restrained dismantling joints for connecting and restraining flanged fittings, pumps, meters, valves, or other miscellaneous flanged service equipment to pipelines where indicated on the drawings. The joints shall provide axial adjustability to facilitate installation, maintenance, and removal of equipment without cutting or welding pipes. The design shall combine a flanged coupling adapter and a flanged spigot into a single telescoping assembly, with integral restraint rods to prevent axial movement under pressure or thrust.
- B. Performance Requirements
 - 1. Working Pressure: 175 psi for nominal pipe sizes 3" through 12"; 150 psi for nominal pipe sizes 14" and larger. Higher pressure ratings shall be provided where specified.
 - 2. Temperature Range: -20°F to +180°F
 - 3. Adjustability: Minimum 6 inches of axial travel; telescoping spool design allowing free movement during installation and service.
 - 4. Testing: Joints shall be hydrostatically tested at 1.5 times the rated working pressure prior to shipment.
- C. Materials
 - 1. Followers: Ductile Iron per ASTM A536 or Carbon Steel per ASTM A576, A36, or A283C.
 - 2. Gasket:
 - a. Water and Sewer: Nitrile (Buna-N), certified NSF 61 for drinking water compliant
 - b. Air: Viton (FKM)
 - 3. Finish: Fusion-Bonded epoxy per AWWA C213
- D. Manufacturer: Provide Smith Blair Style 975 or equal.

2.04 GROOVED COUPLINGS

- A. Mechanical couplings shall be Victaulic Style 31 cast of ductile iron conforming to ASTM A-536, grade 65-45-12, with an alkyd-phenolic primer coating with a FlushSeal synthetic rubber gasket and plated nuts and bolts.

- B. Bolts shall be heat-treated plated carbon steel, meeting the physical and chemical requirements of ASTM A-449 and physical requirements of ASTM A-183. For buried or submerged service bolts and nuts shall be Type 316 stainless steel conforming to ASTM A-193, Grade B-8.

2.05 RUBBER EXPANSION JOINTS

- A. The expansion joint shall consist of an inner tube, body, and outer cover, and shall have flanged ends. The tube shall be synthetic material. The body shall consist of fabric and rubber compounds reinforced with steel wire for strength. The body materials shall be compatible with the tube and shall be suitable for the specified service conditions.
- B. Flanges shall be constructed integrally with the body to resist stress. Flanges are full pattern so that gaskets are not necessary.
- C. Flanges shall be drilled to ANSI B 16.5, Class 150#, or as required to match the piping system.
- D. Expansion joints used in air service applications must have a temperature rating that meets the requirements of the installed blower system.
- E. Expansion joints shall be Redflex Type J-1 as manufactured by the Red Valve Company, or equal by Mercer Rubber Company.

2.06 METAL FLEXIBLE PIPE CONNECTORS

- A. Braided flexible connectors shall consist of braided metal hose, with inlet and outlet 150# carbon steel plate flange connections. Provide 316 stainless steel flanges to match pipe material as required.
- B. The connectors shall be engineered to move laterally, absorb vibration, and shall impart no thrust loads to system anchors.
- C. Materials of construction of the braided connector hose to be corrugated stainless steel with a stainless steel braid.
- D. Connectors shall be designed to meet the design pressure and temperature requirements for the system.
- E. Braided flexible connectors shall be Flexicraft Industries, Model FF, Thunder Technologies LLC or equal.

2.07 COATINGS

- A. Provide the factory applied coating listed above, where a coating system is not specified provide a factory applied primer compatible with painting systems specified in the Painting Section 09 91 00.
- B. A field applied finished coating shall be applied to the coupling and adapters per Painting Section 09 91 00 and Identification for Process Piping Section 40 05 95.

2.08 SPARE PARTS

- A. Provide two (2) spare gasket sets and two (2) spare track head bolt sets for each size and type of coupling.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install pipe couplings and adaptors as shown on the Drawings, following the manufacturer's instructions and referenced standards. Flanges must be installed level and square to the pipe, and mechanical couplings must be tightened to the specified bolt torque.
- B. Use a lubricant recommended by the coupling manufacturer when seating all gaskets.
- C. The pipe shall be furnished with plain ends for couplings in accordance with AWWA C200 Steel Water Pipe Specifications.
- D. After installation and testing, field-paint the couplings in accordance with the requirements in the Painting Section 09 91 00.

3.02 PRESSURE TESTING

- A. All pipe joints and interconnections shall be pressure tested in accordance with the requirements of Section 40 05 01 - Common Work Results for Process Piping.

END OF SECTION

SECTION 40 05 07

HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Scope

1. This section covers the requirements for pipe hangers, supports, anchors, and guides for all above-ground process piping systems.

1.02 RELATED DOCUMENTS

A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 33 00 – Submittal Procedures

1.03 REFERENCES

A. ASME Standards:

1. ASME B31.3 - Process Piping

B. ASTM International:

1. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

C. Manufacturers Standardization Society

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
2. MSS SP-69 - Pipe Hangers and Supports - Selection and Application
3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.04 SUBMITTALS

A. Submit shop drawings of pipe hangars and supports in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.

B. Product Data:

1. Submit product data on all hanger and support devices, including shields and attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers for pipe hangers and supports include:
 1. Anvil International
 2. Cooper B-Line
 3. Empire Industries, Inc.
 4. National Pipe Hanger Corporation
 5. Or equal.
- B. The referenced model numbers are for Copper B-Line series pipe supports. The manufacturer shall submit their standard products that are equivalent to the listed model.

2.02 GENERAL REQUIREMENTS

- A. Hangers and supports shall be capable of supporting the design loads including the weight of pipe, contents, insulation, and thrust loads.
- B. Hangers and supports shall allow for adequate pipe movement due to thermal expansion/contraction.
- C. Hangers and supports shall be fabricated from materials compatible with the piping material.
- D. Any submerged hangers and supports shall be 316 stainless steel.
- E. Above-ground hangers and supports shall be hot-dip galvanized steel, stainless steel, or other corrosion-resistant material.

2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers
 1. Uninsulated pipes 2 inch and smaller:
 - a. Adjustable steel swivel ring (band type) hanger, B-Line series B3170.
 - b. Adjustable steel swivel J-hanger, B-Line series B3690.
 - c. Malleable iron ring hanger, B-Line series B3198R or hinged ring hanger, B3198H.
 - d. Malleable iron split-ring hanger with eye socket, B-Line series B3173 with B3222.
 - e. Adjustable steel clevis hanger, B-Line series B3104 or B3100.

2. Uninsulated pipes 2-1/2 inch and larger:
 - A. Adjustable steel clevis hanger, B-Line series B3100.
 - B. Pipe roll with sockets, B-Line series B3114.
 - C. Adjustable steel yoke pipe roll, B-Line series B3110.
 - D. Insulated pipe- Hot or steam piping:
3. 2 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. B-Line series B3100 with B3151 products.
4. 2-1/2 inch and larger pipes:
 - A. Adjustable steel yoke pipe roll with pipe covering protection saddle. B-Line series B3110 with B3160-B3165 products.
 - B. Pipe roll with sockets with pipe covering protection saddle, B-Line series B3114 with B3160-B3165 products.
 - 1) Insulated pipe- Cold or chilled water piping:
 - 2) 5 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. B-Line series B3100 with B3151 series.
5. 6 inch and larger pipes:
 - A. Pipe roll with sockets with pipe covering protection saddle, B-Line series B3114 with B3160-B3165 series.
 - B. Adjustable steel yoke pipe roll with pipe covering protection saddle. B-Line series B3110 with B3160-B3165 products.

B. Pipe Clamps

1. When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, B-Line series B3140 or B3142 with B3200. For insulated lines use double bolted pipe clamps, B-Line series B3144 or B3146 with B3200.

C. Multiple or Trapeze Hanger

1. Trapeze hangers shall be constructed from 12-gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8 inch minimum, B-Line series B22 strut or stronger as required.
2. Mount pipes to trapeze with 2-piece pipe straps sized for outside diameter of pipe, B-Line series B2000 products.
3. For pipes subjected to axial movement:
 - A. Strut mounted roller support, B-Line series B3126. Use pipe protection shield or saddles on insulated lines.

- B. Strut mounted pipe guide, B-Line series B2417.
- D. Wall Supports
 - 1. Pipes 4 inch and smaller:
 - A. Carbon steel hook, B-Line series B3191.
 - B. Carbon steel J-hanger, B-Line series B3690.
 - 2. Pipes larger than 4 inches:
 - A. Welded strut bracket and pipe straps, B-Line series B3064 and B2000 series.
 - B. Welded steel brackets, B-Line series B3066 or B3067, with roller chair or adjustable steel yoke pipe roll. B-Line series B3120 or B3110. Use pipe protection shield or saddles on insulated lines.
- E. Floor Supports
 - 1. Hot piping under 6 inches and all cold piping:
 - A. Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. B-Line series B3093 and B3088T or B3090 and B3088. Pipe saddle shall be screwed or welded to appropriate base stand.
 - 2. Hot piping 6 inch and larger:
 - A. [Adjustable] Roller stand with base plate, B-Line series B3117SL [or B3118SL]
 - B. Adjustable roller support and steel support sized for elevation, B-Line series B3124.
- F. Vertical Supports
 - 1. Steel riser clamp sized to fit outside diameter of pipe, B-Line series B3373.
- G. Copper Tubing Supports
 - 1. Hangers shall be sized to fit copper tubing outside diameters.
 - A. Adjustable steel swivel ring (band type) hanger, B-Line series B3170CT.
 - B. Malleable iron ring hanger, B-Line series B3198RCT or hinged ring hanger B3198HCT.
 - c. Malleable iron split-ring hanger with eye socket, B-Line series B3173CT with B3222.
 - d. Adjustable steel clevis hanger, B-Line series B3104CT.
 - 2. For supporting vertical runs use epoxy painted or plastic-coated riser clamps, B-Line series B3373CT or B3373CTC.
 - 3. For supporting copper tube to strut use epoxy painted pipe straps sized for copper tubing, B-Line series B2000 series, or plastic inserted vibration isolation clamps, B-Line series BVT products.

H. Plastic Pipe Supports

1. V-Bottom clevis hanger with galvanized 18-gauge continuous support channel, B-Line series B3106 and B3106V, to form a continuous support system for plastic pipe or flexible tubing.

I. Supplementary Structural Supports

1. Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line, Inc (DBA Eaton). Channels shall be roll formed, 12-gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch by 1 5/8 inch or greater as required by loading conditions. Submit designs for pipe tunnels, pipe galleries, etc., to the Engineer for approval. Use clamps and fittings designed for use with the strut system.

2.04 UPPER ATTACHMENTS

A. Beam Clamps

1. Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
2. C-Clamps shall have locknuts and cup point set screws, B-Line series B351L, or B3036L. Top flange c-clamps shall be used when attaching a hanger rod to the top flange of structural shapes, B-Line series B3034 or B3033. Refer to manufacturers recommendation for setscrew torque. Retaining straps shall be used to maintain the clamps position on the beam where required.
3. Center loaded beam clamps shall be used where specified. Steel clamps shall be B-Line series B3050, or B3055. Malleable iron or forged steel beam clamps with cross bolt shall be B-Line series B3054 or B3291-B3297 solutions as required to fit beams.

B. Concrete Inserts

1. Cast in place spot concrete inserts shall be used where applicable; either steel or malleable iron body, B-Line series B2500 or B3014. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rod sizes, B-Line series N2500 or B3014N series.
2. Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete, B- Line series B22I, 32I, or 52I. Select channel nuts suitable for strut and rod sizes.

2.05 VIBRATION ISOLATION AND SUPPORTS

- A. For refrigeration, air conditioning, hydraulic, pneumatic, and other vibrating system applications, use a clamp that has a vibration dampening insert and a nylon inserted locknut. For copper and steel tubing use B-Line series BVT Vibra-Clamp™, for pipe sizes use BVP series.
- B. For larger tubing or piping subjected to vibration, use neoprene or spring hangers as required.

- C. For base mounted equipment use vibration pads, molded neoprene mounts, or spring mounts as required.
- D. Vibration isolation products as manufactured by Cooper B-Line, Inc. (DBA Eaton) Vibratrol systems.

2.06 ACCESSORIES

- A. Hanger Rods shall be threaded both ends, or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
- B. Shields shall be 180-degree galvanized sheet metal, 12 inch minimum length, 18-gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line series B3151.
- C. Pipe protection saddles shall be formed from carbon steel, 1/8-inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inches shall have a center support rib.

2.07 FINISHES

- A. Indoor Finishes
 - 1. Hangers and clamps for support of bare copper piping shall be coated with copper colored epoxy paint, B-Line series Dura-Copper™. Additional PVC coating of the epoxy painted hanger shall be used where necessary.
 - 2. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish, B-Line series Dura Green™.
 - 3. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line series Dura Green.
- B. Outdoor and Corrosive Area Finishes
 - 1. Hangers and strut located outdoors shall be hot dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.
 - 2. Hangers and strut located in corrosive areas shall be type 304 [316] stainless steel with stainless steel hardware.

PART 3 - EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

- A. Pipe shall be adequately supported by pipe hanger and supports specified in PART 2 PRODUCTS. Hangers for insulated pipes shall be sized to accommodate insulation thickness.
- B. Horizontal steel piping shall be supported in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

NOMINAL PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	MAXIMUM SPACING (FEET)
1/2 to 1-1/4	3/8	7
1-1/2	3/8	9
2	3/8	10
2-1/2	1/2	11
3	1/2	12
3-1/2	1/2	13
4	5/8	14
5	5/8	16
6	3/4	17
8	3/4	19
10	7/8	22
12	7/8	23
14	1	25
16	1	27

- C. Horizontal copper tubing shall be supported in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

NOMINAL PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	MAXIMUM SPACING (FEET)
1/2 to 3/4	3/8	5
1	3/8	6
1-1/4	3/8	7
1-1/2	3/8	8
2	3/8	8
2-1/2	1/2	9
3	1/2	10
3-1/2	1/2	11
4	1/2	12
5	1/2	13
6	5/8	14
8	3/4	16

- D. Provide means of preventing dissimilar metal contact such as plastic-coated hangers, copper colored epoxy paint, or non-adhesive isolation tape- B-Line series Iso-pipe. Galvanized felt isolators sized for copper tubing may also be used, B-Line series B3195CT.
- E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- F. Install hangers to provide a minimum of 1/2 inch space between finished covering and adjacent work.

- G. Place a hanger within 12 inches of each horizontal elbow.
 - H. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.
 - I. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in section 2.02 C. Trapeze hangers shall be spaced according to the smallest pipe size or install intermediate supports according to schedule in section 3.01B.
 - J. Do not support piping from other pipes, ductwork or other equipment that is not building structure.
- 3.02 CONCRETE INSERTS
- A. Provide inserts for placement in formwork before concrete is poured.
 - B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - C. Where concrete slabs form finished ceilings, provide inserts to be flush with slab surface.
 - D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

END OF SECTION

SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes ductile iron pipe and fittings for process service, linings and coatings for chemical resistance, process-specific accessories and appurtenances, and testing and quality requirements.
- B. All piping systems must be suitable for their intended purpose, meeting both functional and safety requirements.
- C. Provide flanged joints for exposed piping and push-on or mechanical joints for buried piping, as specified in Section 33 05 19, "Ductile Iron Utility Pipe." Use couplings for plain-ended pipes as shown or approved.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 09 91 00 – Painting
 - 3. Section 33 13 00 – Disinfection of Water Systems
 - 4. Section 33 05 05 – Buried Pipe Installation
 - 5. Section 33 05 19 – Ductile Iron Utility Pipe
 - 6. Section 40 05 00 - Common Work Results for Process Piping Interconnections
 - 7. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
 - 8. Section 40 05 07 - Hangers and Supports for Process Piping
 - 9. Section 40 05 51 - Common Requirements for Process Valves
 - 10. Section 40 05 97 - Identification for Process Piping

1.03 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C104 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings
 - 2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings

3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast
6. AWWA C153 - Ductile-Iron Compact Fittings
7. AWWA C606 - Grooved and Shouldered Joints

B. ASTM International (ASTM):

1. ASTM A53 - Specification for Pipe, Steel, Black and Hot-dipped, Zinc- Coated, Welded and Seamless.
2. ASTM B16.1 - Cast Iron Pipe Flanges and Flanged Fittings
3. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

C. ASME Standards:

1. ASME B31.3 - Process Piping
2. ASME B16.5 - Pipe Flanges and Flanged Fittings
3. ASME B16.5 - Malleable Iron Threaded Pipe Unions

D. NSF International

1. NSF 61 - Drinking Water System Components

E. Ductile Iron Pipe Research Association (DIPRA)

1. Installation Guide for Ductile Iron Pipe

1.04 SUBMITTALS

- A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00. Submit the following along with all items required per section 33 05 05 Buried Pipe Installation.

B. Product Data:

1. Cutsheets and catalog information for the following: pipe materials and pressure classes, fitting details and pressure ratings, lining and coating systems with chemical resistance data, bolts, and flange ratings and facing types.
2. Gasket material temperature rating, pressure rating, and chemical compatibility.
3. Dissimilar metal dielectric joints and gaskets.
4. Surface preparation and application reports and procedures as required for lining and coating of pipe and fittings.

C. Shop Drawings:

1. Scaled detailed piping layout drawings showing all pipe, fittings, valves, gaskets, linings and coatings for the entire piping system.
2. The drawings shall also include all hangar and support locations, expansion joint locations and the interface with equipment.

D. Quality Assurance/Control Submittals:

1. Manufacturer's certification of materials
2. Coating application certificates
3. Welding certificates, if applicable
4. Material traceability documentation, if applicable

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The manufacturer must have an ISO 9001 certified facility with at least five years of experience in process pipe manufacturing.

B. Installer Qualifications:

1. The installer must have at least 5 years of experience in process piping installation and demonstrated expertise with similar systems. Certified welders are required where applicable.
2. Welders shall be ASME qualified within the previous 12 months for employed weld types.

C. Regulatory requirements:

1. Pipes and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, must be certified by an accredited organization in accordance with NSF 61.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Provide factory-applied end caps on pipes at the factory to keep debris, dust, and moisture from entering and potentially contaminating or damaging the pipe interior.
2. Label each pipe section with unique identifiers to ensure proper traceability and installation.
3. Protect flanged ends during shipping to bending, cracking, or distortion.
4. Provide coating protection during shipping.

B. Storage:

1. When possible, store pipes indoors to protect them from rain, direct sunlight, and temperature fluctuations.

2. If indoor storage isn't possible, use tarps, covers, or other protective materials to shield pipes from moisture, dust, and harsh weather.
3. Position pipes on stable, non-reactive blocking materials that prevent direct contact with the ground.

C. Handling

1. Refer to Section 40 05 00 - Common Work Results for Process Piping Interconnections.

1.07 EXISTING CONDITIONS

- A. Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. American Cast Iron Pipe Company
2. U.S. Pipe
3. McWane Ductile
4. Or approved equal

2.02 MATERIALS

A. Ductile Iron Pipe:

1. Flange pipe shall be fabricated per AWWA C115 / ANSI A21.15, pressure-rated per piping schedules, with minimum Thickness Class 53
2. Non-Flanged Pipe shall conform to AWWA C151 / ANSI A21.51 for pressure, dimensions, tolerances, and markings.
 - a. Piping shall meet the following minimum pressure class unless noted otherwise.
 - 1) 3 to 12 inches - Pressure Class 350
 - 2) 14 to 24 inches - Pressure Class 250 (*Note 1*)
 - 3) 30inch and greater - Pressure Class 150 (*Note 1*)

Note 1: Higher Pressure Classes may be required depending on depth of bury and laying conditions.

3. Each pipe must undergo a hydrostatic pressure test of at least 500-psi at the point of manufacture.
4. All ductile iron pipes should be designed to a minimum of 150 psi working pressure, with a 100 psi surge allowance, and a 2:1 safety factor based on the combined working and surge

pressures. Pipes should also meet single AASHTO H-20 truck loading, laying condition 2, and specified cover requirements.

5. Each pipe length must be clearly marked with its class or nominal thickness, net weight (unlined), casting period, manufacturer's mark, production year, and "D.I." or "Ductile Iron."

B. Fittings:

1. All fittings to meet requirements of AWWA C 110 / ANSI A21.10, or AWWA C153/ ANSI A21.53.
2. The pressure rating of the gaskets, bolts, and nuts should match the specifications set for mechanical or flanged joints.
3. The pressure rating of fittings shall meet the specified pressure rating or special thickness class of the connected pipe.

C. Pipe Joints:

1. General
 - a. Pipe joints shall meet requirements of AWWA C 110 / ANSI A21.10, or AWWA C153/ ANSI A21.53.
 - b. Pipe joints shall match the pressure rating of the piping system.
2. Flanged Joints:
 - a. Provide flat face flanges unless note otherwise.
 - b. Gaskets shall be 1/8-inch thick, ring or full-face design compatible with process fluid.
3. Mechanical Joints:
 - a. Capable of meeting pressure rating or special thickness class, and test pressure per Section 33 05 05, Buried Piping Installation.
 - b. Supply mechanical joint with standard ductile iron retainer gland unless noted otherwise.
4. Push-On Joints:
 - a. Each plain end should be marked with a circular stripe to serve as a visual guide to ensure proper joint assembly.
 - b. Products and Manufacturers:
 - 1) Fastite Joint by American Cast Iron Pipe Co.
 - 2) Tyton Joint by U.S. Pipe and Foundry Co.
 - 3) Or equal.
5. Restrained Joints:

- a. Provide restrained joint ductile iron pipes and fittings where shown on Drawings. Joints shall meet the indicated pressure class and be composed of mechanical or push-on joints with restrained gaskets.
 - b. Restrained joints shall meet the indicated pressure class and consist of one of the following
 - 1) Push-on Joints with restrained gaskets: Acceptable types include:
 - a) Amarillo “Fast-Grip” by American Cast Iron Pipe Co. (Up to 30”)
 - b) “Field-Lok” by U.S. Pipe and Foundry Co. (up to 24”)
 - c) Or Equal
 - 2) Push-on Joint with locking ring or similar mechanism. Acceptable types include
 - a) “HDSS” by US Pipe
 - b) “Flex-Ring” by American Cast Iron Pipe Co.
 - c) “Lok-Ring” by American Cast Iron Pipe Co.
 - d) “TR Flex” by McWane Ductile
 - e) Or Equal
 - c. Restrained Joint fittings shall be mechanical joint with wedge action gland. Acceptable types include:
 - 1) One-Lock Series SLDE, by Sigma
 - 2) Series 1100, by EBBA Iron Sales, Inc.
 - 3) Stargrip Series 3000, by Star Pipe Products
 - 4) Or equal.
6. Gasket Materials
- a. Sewers: Styrene Butadiene Rubber (SBR) conforming to ANSI A21.11
 - b. Water: Styrene Butadiene Rubber (SBR) or EPDM in accordance with ANSI A21.11
 - 1) Gaskets for potable water service must be NSF 61 compliant.
 - c. Air: FKM (Viton or equal)
7. Hardware
- a. Bolts shall be ASTM A307 Grade A carbon steel with chamfered or rounded ends projecting $\frac{1}{4}$ to $\frac{1}{2}$ inch beyond the outer face of nut.
 - b. Nuts to be ASTM A563, hexagonal, ANSI/ASME B18.2.2.

- c. Hardware located in the following environments, or where indicated on the Drawings, shall be 316 stainless steel.
 - 1) Sewer wet wells
 - 2) Submerged service
 - 3) Chemicals
- d. Provide plastic bolt sleeves and washers for insulating joints.

2.03 LININGS AND COATINGS

A. Interior Linings (select based on service):

- 1. Pipe and fittings shall be lined with a bituminous asphalt coating in accordance with AWWA C104 / ANSI A21.4 / NSF 61 for water applications, except as noted below:
- 2. Gravity sewer pipes shall be cement lined in accordance with AWWA C104 / ANSI A21.4.
- 3. Air pipe shall be unlined.

B. Exterior Coatings:

- 1. Underground pipe and fittings shall be provided with an asphaltic coating in accordance with AWWA C151.
- 2. For exposed pipes and fitting provide a factory applied primer compatible with painting systems specified in the Painting Section 09 91 00.

2.04 ACCESSORIES

A. Coupling and Adaptors

- 1. Refer to Section 40 05 06 Couplings, Adapters, and Specials for Process Piping.

B. Pipe Supports:

- 1. Refer to Section 40 05 07 Hangers and Supports for Process Piping.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine and verify pipe markings, inspect for damage, and confirm lining and coating integrity before installation.

3.02 INSTALLATION

A. General:

1. Installation should follow ASME B31.3 and manufacturer instructions. Joints must be clean, gaskets properly installed, bolts torqued per specifications, and alignment maintained. Damaged coatings should be repaired as per the manufacturer's guidance.

B. Joints:

1. Clean surfaces thoroughly to ensure that all joint surfaces, including pipe ends and gasket contact points, are completely free of debris, oils, and moisture before assembly to prevent leaks and ensure a tight seal.
2. Install gaskets properly, ensure the gasket is the correct size and material, and is free of defects. Clean the flange and gasket surfaces and remove any debris. Center the gasket between the flanges, making sure it's centered.
3. Tighten bolts according to the manufacturer's recommended torque values to avoid over- or under-tightening, which can lead to joint failure or leakage.
4. During assembly, keep the pipes and joints correctly aligned to avoid strain on the connections and reduce stress on the pipe.

C. Coatings:

1. Inspect all coated surfaces and promptly apply touch-up coating to any spots where damage is detected, restoring protection against corrosion and wear.
2. Conduct testing to identify any pinholes or gaps ("holidays") in the coating that could expose the metal beneath, ensuring the coating provides continuous coverage.
3. Repair any damaged areas following the specific repair methods and materials recommended by the manufacturer to maintain coating performance and meet project standards.

3.03 FIELD QUALITY CONTROL

A. Testing:

1. For buried piping installation and testing, refer to Section 33 05 05, Buried Piping Installation.

B. Inspection:

1. Check that all piping and connections are properly aligned to prevent strain on joints.
2. Ensure that pipe supports are correctly installed, providing necessary stability and load distribution.
3. Inspect all joints to confirm proper assembly, ensuring they meet quality standards.

- C. Examine the pipe coating for continuity and any damage that might expose the pipe to corrosion.

3.04 CLEANING

- A. Remove any construction debris, dust, or other foreign materials from the pipe interior.

- B. Flush the piping system as needed to ensure it is free of any remaining particles or residue.

- C. Dispose of used cleaning water in accordance with environmental regulations and project requirements.

3.05 PROTECTION

- A. Protect the installed pipe from physical impacts or environmental factors that could cause damage.
- B. Maintain end protection to protect the interior until final connections are made.
- C. Protect the coating from damage to ensure the protective coating on the pipe remains undamaged.

END OF SECTION

SECTION 40 05 23

STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes stainless steel process pipe and tubing and fittings for process service, process-specific accessories and appurtenances, and testing and quality requirements.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 33 13 00 – Disinfection of Water Systems
 - 3. Section 40 05 00 - Common Work Results for Process Piping Interconnections
 - 4. Section 40 05 07 - Hangers and Supports for Process Piping
 - 5. Section 40 05 51 - Common Requirements for Process Valves
 - 6. Section 40 05 97 - Identification for Process Piping

1.03 REFERENCES

- A. ASTM International:
 - 1. ASTM A182 - Forged or Rolled Alloy and Stainless Steel Pipe Flanges
 - 2. ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing
 - 3. ASTM A403 - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
 - 4. ASTM A813 - Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe
 - 5. ASTM A814 - Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe
- B. ASME STANDARDS:
 - 1. ASME B1.20.1 - Pipe Threads, General Purpose
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings
 - 3. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings

4. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded
5. ASME B16.20 - Metallic Gaskets for Pipe Flanges
6. ASME B31.3 - Process Piping
7. ASME B36.19M - Stainless Steel Pipe

C. AWS STANDARDS:

1. AWS D18.1 - Specification for Welding of Austenitic Stainless Steel
2. AWS A5.9 - Specification for Bare Stainless Steel Welding Electrodes

1.04 SUBMITTALS

A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00. Submit the following along with all items required per section 33 05 05 Buried Pipe Installation.

B. Product Data:

1. Cutsheets and catalog information for the following: pipe materials and pressure classes, fitting details and pressure ratings, chemical resistance data, bolts, and flange ratings and facing types.
2. Gasket material temperature rating, pressure rating, and chemical compatibility.
3. Dissimilar metal dielectric joints and gaskets.

C. Shop Drawings:

1. Scaled detailed piping layout drawings showing all pipe, fittings, valves, and gaskets for the entire piping system.
2. The drawings shall also include all hangar and support locations, expansion joint locations and the interface with equipment.

D. Quality Assurance/Control Submittals:

1. Manufacturer's certification of materials
2. Welding certificates, if applicable
3. Material traceability documentation, if applicable

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The manufacturer must have an ISO 9001 certified facility with at least five years of experience in process pipe manufacturing.

B. Installer Qualifications:

1. The installer must have at least 5 years of experience in process piping installation and demonstrated.
2. Welders shall be ASME qualified within the previous 12 months for employed weld types.

C. Regulatory requirements:

1. Pipes and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, must be certified by an accredited organization in accordance with NSF 61.

D. DELIVERY, STORAGE, AND HANDLING

1. Refer to Section 40 05 00 - Common Work Results for Process Piping Interconnections.

PART 2 - PRODUCTS

2.01 STAINLESS STEEL PIPING SYSTEMS

A. SS1 - Stainless Steel General Service Piping:

1. Services: Where scheduled for air, water, or other services.
2. Pipe: ASTM A312,
3. Type: Minimum schedule 10S (unless otherwise noted on the pipe schedule)
4. Joints: Buttwelded, beveled ends
5. Grade: Type 316L unless otherwise indicated
6. Fittings:
 - a. ASTM A403/A403M, Class WP-W
 - b. Wrought stainless steel, grade equivalent to pipe
 - c. Buttwelded, beveled ends, minimum schedule 10S unless otherwise noted on the pipe schedule (Match Pipe)

B. SS2 – Stainless Steel with Threaded Fittings

1. Services: Gauge piping in stainless steel piping systems, air release valves, and other similar services
2. Pipe: ASTM A312
3. Type: Minimum schedule 40S (unless otherwise noted on the pipe schedule)
4. Joints: Threaded
5. Grade: Type 316L unless otherwise indicated
6. Fittings:

- a. Comply with ASME B16.11 and ASTM A182.
- b. Grade: Type 316L unless otherwise indicated
- c. Threads: Comply with ASME B1.20.1.

C. SS3- Stainless Steel Tubing with Compression Fittings

- 1. Services: Instrumentation tubing and other similar services
- 2. Tubing: ASTM A269
- 3. Thickness: Minimum 18 gauge
- 4. Joints: Compression
- 5. Grade: Type 316L unless otherwise indicated
- 6. Fittings:
 - a. Compression type, Crawford “Swagelok”, Parker “CPI”, Parker “Ferulok”, or equal
 - b. Grade: Type 316L unless otherwise indicated

2.02 FLANGED CONNECTIONS:

- A. Class as required to connect stainless-steel piping to fittings and equipment.
- B. Stainless steel lap-joint or Vanstone type rolled angle face rings with thickness at least equal to pipe wall.
- C. Flange Gaskets:
 - 1. Comply with ASME B16.5.
 - 2. Nonmetallic Gaskets:
 - a. Material: Chloroprene rubber.
 - b. Comply with ASME B16.21.
- D. Flange Hardware:
 - 1. Type 316, heavy hex head pattern
 - 2. Bolts: ASTM A193, Class 2, ANSI B18.2.1
 - 3. Nuts: ASTM A194, ASME B18.2.2

2.03 ACCESSORIES

- A. Unions:
 - 1. Material: Type 316L
 - 2. Rating: Class 150 minimum

- 3. End connection: Match pipe
- B. Metallic Ring Joint Gaskets:
 - 1. Comply with ASME B16.20.
- C. Type:
 - 1. Raised-Face Flanges: Flat ring.
 - 2. Flat-Face Flanges: Full face.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field dimensions are as indicated on shop Drawings.
- B. Inspect flanges for nonstandard bolt hole configurations or design, and verify that new pipe and flange mate properly.

3.02 PREPARATION

- A. Ream pipe and tube ends and remove burrs.
- B. Thoroughly clean pipe and fittings before installation.

3.03 INSTALLATION

- A. General:
 - 1. Install per ASME B31.3
 - 2. Run piping straight along alignment as indicated on shop Drawings, with minimum number of joints.
- B. Fittings:
 - 1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
 - 2. Install according to manufacturer instructions.
 - 3. Bolting:
 - a. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
 - b. Use torque wrench to tighten bolts to manufacturer instructions.
- C. Provide required upstream and downstream clearances from devices as indicated on shop Drawings.
- D. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.

- E. Support exposed piping as specified in Section 40 05 07 - Hangers and Supports for Process Piping.
 - F. Provide expansion joints as specified in Section 40 05 06 - Couplings, Adaptors, and Specials for Process Piping, and pipe guides as specified in Section 40 05 07 - Hangers and Supports for Process Piping, to compensate for pipe expansion due to temperature differences.
 - G. Provide dielectric fittings between dissimilar metals.
 - H. Field cuts shall be made according to pipe manufacturer instructions.
- 3.04 FIELD QUALITY CONTROL
- A. Inspection
 - 1. Inspect for damage to piping or tubing that may be detrimental as determined by the Engineer.
 - 2. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.
 - 3. Contractor to repair damaged piping, or provide new, undamaged pipe.
 - B. Testing:
 - 1. Contractor to conduct hydrostatic test per ASME B31.3.
 - 2. Contractor to provide pressure test documentation.
- 3.05 CLEANING
- A. Keep pipe interior clean as installation progresses.
 - B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION

SECTION 40 05 31

THERMOPLASTIC PROCESS PIPE

PART 1 - GENERAL

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Charlotte Pipe
2. Spears Manufacturing
3. Or approved equal

2.02 SCH 80 PVC PIPE AND FITTINGS

- A. Services: Chemical piping, control piping (where scheduled), water piping (where scheduled), and other services as scheduled.
- B. Material: Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a cell class of 12454 as identified in ASTM D 1784
- C. Standards: Pipe and fittings shall conform to NSF International Standard 61 and the health effects portion of NSF Standard 14.
- D. Pressure Rating at 73°F: 160 psi minimum
- E. Temperature Range: For operating temperatures below 140° F.
- F. Color: Gray
- G. Pipe:
1. Manufacturing Standard: Iron Pipe Size (IPS) conforming to ASTM D 1785
- H. Fittings:
1. Solvent Cement Socket for standard installation conforming to ASTM D2467
 2. Threaded where specified or required conforming to ASTM D2464
 3. Flanged where specified or required
- I. Accessories
1. Primer: P70 conforming to ASTM F656
 2. Solvent: 724 conforming to ASTM F493

- 3. Thread lubricant: Teflon
- 2.03 SCH 80 CPVC PIPE:
- A. Services: Provide where scheduled or indicated on the drawings
 - B. Material: Pipe and fittings shall be manufactured from virgin rigid CPVC (chlorinated polyvinyl chloride) vinyl compounds with a cell class of 24448, as identified in ASTM D 1784
 - C. Standards: Pipe and fittings shall conform to NSF International Standard 61 and the health effects portion of NSF Standard 14.
 - D. Pressure Rating at 73°F: 160 psi minimum
 - E. Temperature Range: For operating temperatures below 200° F.
 - F. Color: Light Gray/Tan
 - G. Pipe
 - 1. Manufacturing Standard: Iron Pipe Size (IPS) conforming to ASTM F 441
 - H. Fittings:
 - 1. Solvent Cement Socket for standard installation conforming to ASTM F439
 - 2. Threaded where specified or required conforming to ASTM F437
 - 3. Flanged where specified or required
 - I. Accessories
 - 1. Primer: P70 conforming to ASTM F656
 - 2. Solvent: 724 conforming to ASTM F493
 - 3. Thread lubricant: Teflon
- 2.04 POLYETHYLENE PIPE AND FITTINGS:
- A. Services: Provide where scheduled or indicated on the drawings
 - B. Pipe: ASTM D2447, Schedule 80, calculated according to ASTM D3035.
 - C. Fittings: Molded; ASTM D3261, butt welded.
 - D. Joints: Butt fusion.
 - E. Materials: ASTM D3350.
- 2.05 POLYETHYLENE TUBE AND FITTINGS:
- A. Services: Provide where scheduled or indicated on the drawings
 - B. Tube:

1. Standard: AWWA C901, ASTM D3035
 2. Pipe Material: PPI TR-4 PE 4710, ASTM D3350 Cell Class, 445574 CC3
 3. Wall Thickness: SDR 9 (250 psi)
- C. Fittings: Compression type; materials suitable for application.
- D. Threads: Straight; ASME B1.1.
- 2.06 ACCESSORIES
- A. Expansion Joints:
1. Refer to Section 40 05 06 Couplings, Adapters, and Specials for Process Piping.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ream pipe ends, remove burrs and bevel plain end pipe.
- B. Thoroughly clean pipe and fittings before installation.

3.02 INSTALLATION

- A. Run piping straight along alignment indicated on Drawings with minimum number of joints.
- B. Install piping and components according to ASME B31.3.
- C. Fittings:
1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
 2. Install fittings according to manufacturer's instructions.
 3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer's recommendations.
- D. Provide required upstream and downstream clearances from devices as indicated.
- E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
- F. Support exposed piping as specified in Section 40 05 29 - Hangers and Supports for Process Piping and Equipment.
- G. Provide expansion joints as specified in Section 40 05 13 - Common Work Results for Process Piping and pipe guides as specified in Section 40 05 29 - Hangers and Supports for Process Piping and Equipment to compensate for pipe expansion due to temperature differences.
- H. Disinfection: Disinfect potable water piping as specified in Section 33 13 00 - Disinfecting of Water Utility Distribution.
- I. Field Cuts: According to pipe manufacturer's recommendations.

- J. Joining:
 - 1. Perform heat joining according to ASTM D2657.
 - 2. Perform electrofusion joining according to ASTM F 1290.
 - 3. Primers and Cleaners: ASTM F402.
 - 4. PVC Solvent-Cemented Joints: ASTM D2855.
 - K. Provide insulation where shown on the Drawings.
 - L. Underground Piping: As specified in Section 33 05 05 Buried Piping Installation.
- 3.03 FIELD QUALITY CONTROL
- A. Inspection
 - 1. Inspect for damage to piping or tubing that may be detrimental as determined by the Engineer.
 - 2. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.
 - 3. Contractor to repair damaged piping, or provide new, undamaged pipe.
 - B. Testing:
 - 1. Contractor to conduct hydrostatic test per ASME B31.3.
 - 2. Contractor to provide pressure test documentation.
- 3.04 CLEANING
- A. Keep pipe interior clean as installation progresses.
 - B. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION

SECTION 40 05 51

COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements for valves used in utility and process piping systems including:
 - 1. Gate Valves
 - 2. Eccentric Plug Valves
 - 3. Butterfly Valves
 - 4. Swing Check Valves
 - 5. Air and Vacuum Valves (Water service)
 - 6. Mud Valves
 - 7. Solenoid Valves

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 09 91 00 - Painting
 - 3. Section 33 05 05 – Buried Pipe Installation
 - 4. Section 33 05 19 – Ductile Iron Utility Pipe
 - 5. Section 33 05 31 – Thermoplastic Utility Pipe
 - 6. Section 40 05 00 - Common Work Results for Process Interconnections
 - 7. Section 40 05 57 - Actuators for Process Valves and Gates

1.03 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

2. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service
 3. AWWA C504 - Rubber-Seated Butterfly Valves
 4. AWWA C515 - Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
 5. AWWA C517 - Resilient-Seated Cast Iron Eccentric Plug Valves
 6. AWWA C508 - Swing-Check Valves for Waterworks Service
 7. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
- B. ASME Standards:
1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings
- C. American Society for Testing and Materials (ASTM):
1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves
 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 A536 - Standard Specification for Ductile Iron Castings
 4. ASTM A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
 5. ASTM B30 - Standard Specification for Copper Alloys
- D. NSF International
1. NSF 61 - Drinking Water System Components
 2. NSF 372 - Drinking Water System Components - Lead Content
- 1.04 SUBMITTALS
- A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
- B. Product Data:
1. Cutsheets and catalog information for the following: manufacturer's literature, illustrations, specifications, and engineering data to include materials of construction, dimensions and weights, pressure ratings, flow characteristics and valve operator details.
- C. Shop Drawings:

1. The shop drawings shall include installation drawings, operator mounting details and wiring diagrams for electric operators.
 - D. Quality Assurance/Control Submittals:
 1. Material compliance certificates
 2. Factory test reports
 - E. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications:
 1. The manufacturer must operate an ISO 9001 certified facility with at least five years of experience in installations for the specified service.
 2. Valve manufacturers must provide the Engineer with written certification confirming that all supplied valves and operators meet the applicable requirements of the specified AWWA standards.
 - B. Testing Requirements:
 1. Hydrostatically test valve bodies as required in the specified AWWA standards and provide certified test reports.
- 1.06 WARRANTY
- A. Provide a warranty against defective materials and workmanship in accordance with the manufacturer's standard literature.
- 1.07 REGULATORY REQUIREMENTS
- A. All products or materials that will come into contact with drinking water must be NSF/ANSI standard 61 and 372 certified.

PART 2 - PRODUCTS

2.01 VALVE BOXES

- A. All valve boxes and valve box risers shall be cast or ductile iron. Valve boxes shall be two-piece heavy roadway type with inside diameter of barrel not less than 5". Valve covers shall weigh a minimum of 13 pounds. They shall be the extension type with screw-type adjustment and with flared base. The minimum thickness of metal shall be 3/16". The word "WATER" or "SEWER" where applicable shall be cast on the cover. The boxes shall be of such length as will be adapted without full extension to the depth of cover required over the pipe at the valve location. A concrete protecting slab shall be required when valve box is not located on a paved area. Installation shall be so that the top is flush

with the protecting slab. Concrete protecting slabs shall not be smaller than 18" square by 6" thick. Valves with bury depth greater than 4' shall be supplied with valve nut extension stems.

2.02 FLOOR STANDS AND EXTENSION STEMS

- A. Floor stands, unless otherwise specified or directed, shall be of the non-rising stem type equipped with a suitable indicator to show at all times the position of the valve and shall be fitted with handwheels of proper size for easy operation. In no case shall more than a 40-pound pull on the crank of the handwheel be required for valve operation. Extension stems shall be designed for non-rising stem valves and shall be equipped with stem guides and handwheel. Suitable anchor bolts shall be furnished with all stem guides. All floor stands shall be set plumb with the operating stem and shall bear evenly on the base plate and masonry. The floor stand or base plate shall be grouted in place as required for a proper installation.

2.03 GATE VALVES (VALVES 2 – 24 INCH)

- A. Manufacturers:
 - a. Crispin
 - b. Dezurik
 - c. Or approved equal
- B. Valves shall be manufactured and tested to meet the requirements of ANSI/AWWA C515. Valves shall meet or exceed the requirements of Underwriters Laboratories Standard UL262 and Factory Mutual Standard 1130.
- C. The rated working pressure of the valve shall be 250 psi.
- D. All valve component castings shall originate in the USA.
- E. The body, bonnet, wedge and seal plate shall be made of ductile iron in accordance with ASTM A536. The wedge shall be totally encapsulated in rubber. This rubber coating shall be permanently bonded to the ductile iron wedge casting and shall meet ASTM D429 tests for rubber to metal bonding. No paint shall be allowed in the wedge and the wedge must not be hollow. Containment of the stem nut must only be on two sides to facilitate easy removal.
- F. There shall be three stem seal O-rings; two in the seal plate which shall be replaceable with the valve in the full open position at rated working pressure, and one under the stem thrust collar. All gaskets shall be O-ring seals. O-rings set in a cartridge shall not be allowed. A grit seal must be present above the seal plate to prevent dirt intrusion.
- G. Valves are to be open left (OL) or open right (OR). Operating nuts are to be painted black (OL) or painted red (OR). The NRS valves shall be provided with a 2 inch square operating nut.

- H. 2 – 16 inch valves must have two polymer thrust washers — one above and one below the thrust collar. Stainless steel thrust washers are not acceptable.
- I. Valves 20 – 24 inch must incorporate a high strength 304 stainless steel stem that is lead free.
- J. All fasteners are to be 304 stainless steel. Socket head bolts shall not be allowed. If only two bolts are used to secure the seal plate, the bolts must be fastened to the bonnet with a drilled and tapped hole in the bonnet.
- K. The body, bonnet and seal plate shall be epoxy coated in accordance with ANSI/AWWA C550 certified to NSF 61. This coating shall be on the interior and the exterior of the valve. The manufacturers name, valve size, year of manufacture, pressure rating "250W", C515 and "DI" shall be cast on the valve.
- L. Each valve shall be tested in accordance with ANSI/AWWA C515, UL262 and FM1130. This shall include hydrostatic pressure testing at 500 psi. A certification of manufacture and testing shall be provided at the municipality's request.
- M. All parts of valves to be considered must be manufactured, assembled and tested in the contiguous USA, and letters of certification must accompany any and all products at the request of municipality.

2.04 GATE VALVES (30 INCHES AND LARGER)

- A. Manufacturers:
 - 1. M&H
 - 2. Mueller
 - 3. Or approved equal
- B. Valves shall be manufactured in accordance with AWWA Standard C500. Valves shall be rated at 150 psi. Valves shall have ends that are either mechanical joint (MJ), flanged, or as specified on the plans, and shall feature a clear waterway equal to the full nominal diameter of the valve.
- C. The valves shall be of the double-disc parallel seat type with either non-rising or rising stems, opening by turning either left or right, as specified. They shall be equipped with either 2-inch square nuts or a handwheel, with an arrow cast into the metal to indicate the direction of opening.
- D. Each valve shall have the manufacturer's name, pressure rating, and year of manufacture cast onto the body.
- E. Before shipment from the factory, each valve shall undergo a hydrostatic shell test at 300 psig. Additionally, each valve shall undergo a hydrostatic seat test at a pressure of 150 psig.
- F. Stuffing Boxes:

1. Stuffing Boxes shall be O-ring seal type with two O-rings located in stem above thrust collar in valves without gearing. There shall be a bronze bushing meeting ASTM B584.

G. Bolts and Nuts:

1. Body and cover bolts and nuts shall meet specification ASTM A307 rust proofed.

H. Wedging:

1. Valves will be bottom wedging type with two part floating wedge contact. The wedge and hook shall be separate castings and not a one piece casting in valves 4-36 inches. In valves 42 and 48 inches the hooks and wedges shall be one piece design with the outside of the wedge area covered with a bronze shoe.

I. Stems:

1. Stems shall be in full conformance with AWWA Specs. Sizes 14-36 inches bronze ASTM B584 with 80,000 tensile strength and cast integral stem collar. 42 and 48 inches shall be type 304 stainless steel.

J. Stem Nuts:

1. Stem nuts shall be made of solid bronze independent of hooks, gates and wedges. No pins will be allowed to retain gates to stem nut.

K. Gates and Gate Rings:

1. Gates shall be high strength cast iron, sturdily proportioned without pockets on backs. Cam surfaces shall open to bottom. Gate rings shall be rolled into dovetailed grooves under pressure to make one inseparable unit. The gate ring face shall be machined to a smooth finish.

L. Case Rings:

1. Bronze case rings shall be screwed into place and the contact face machined to a smooth finish. Use of screws, rivets or other means of retention will not be acceptable.

- M. Valves installed with stem horizontal shall be equipped with bronze rollers, tracks, and scrapers.

2.05 ECCENTRIC PLUG VALVES

A. Manufacturers:

1. Crispin
2. DeZurik
3. Or approved equal

- B. Plugs shall be solid one piece, Cast Iron ASTM A126 Class B or Ductile Iron ASTM 536 Grade 65-45-12. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat until at least 90% closed. Resilient plug facing shall be Chloroprene.
- C. Bodies and covers shall be Cast Iron ASTM A126 Class B. Ports shall be rectangular. Round ports are not acceptable. Bearings shall be sleeve type and made of sintered, oil impregnated permanently lubricated type 316 stainless steel for sizes 4-18 inches and ASTM A743 Grade CF8M for sizes 20-36 inches. In valves larger than 36 inches, the upper and lower plug journals shall be fitted with ASTM A240 type 316 stainless sleeves with body bearings of ASTM B30, Alloy C95400 aluminum bronze.
- D. Seats shall be 1/8 inch thick welded overlay of not less than 95% pure nickel. Seat shall be at least 1/2 inch wide, 1/8 inch thick through entire width and raised. The raised surface shall be completely covered with nickel to ensure that the resilient plug face contacts only the nickel seat.
- E. Adjustable packing shall be Acrylonitrile-Butadiene (NBR) multiple V-ring type, with a packing gland follower. Packing gland shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly, except the gland follower.
- F. Pressure ratings shall be 175 psi on valve sizes through 12 inches and 150 psi for 14 inches and larger. Every valve shall be given a certified hydrostatic shell test and seat test, with test reports being available upon request.
- G. All valves larger than 6 inches shall be installed with worm gear actuators. All gearing shall be enclosed in a cast iron housing, with outboard seals to protect the bearings and other internal components. The actuator shaft and gear quadrant shall be supported on permanently lubricated bronze bearings.
- H. Buried actuators shall be 90% grease filled. Input shaft and fasteners shall be stainless steel. Actuator mounting brackets shall be totally enclosed. Other actuators to be installed according to Drawings or as specified.
- I. End connections shall meet or exceed the latest revisions of AWWA C517 and other applicable standards. End Connections shall be Flanged drilled per ASME B16.1 and/or mechanical joint per AWWA C111.

2.06 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. DeZurik
 - 2. Pratt
 - 3. Or approved equal

- B. Butterfly valves shall meet or exceed the latest revision of AWWA Standard C504. All valves shall comply with the requirements of the AWWA class to match the installed piping system, minimum 150# flanges.
- C. Valve bodies shall be of cast iron per ASTM A126 Class B. Flanged end valves shall be of the short body design. Valves shall have Class 125 flanged ends faced and drilled per ASME B16.1 standard for cast iron flanges. Mechanical joint end valves shall meet the requirements of AWWA C111.
- D. Discs shall be offset to provide an uninterrupted 360 degree seating edge and shall be ductile iron per ASTM A536, Grade 65-45-12. The disc seating edge shall be solid 316 stainless steel. The disc shall be securely attached to the valve shaft using 316 stainless steel torque screws or pins.
- E. Valve shafts shall be of type 316 stainless steel. Valve shaft seals shall be self-compensating V-type packing with a minimum of four sealing rings.
- F. Seat shall be of Acrylonitrile-Butadiene (NBR) for water, or as required for other services, and shall be molded in and vulcanized to the valve body. The seat shall contain an integral shaft seal protecting the valve bearings and packing from any line debris.
- G. Valve shaft bearings shall be PTFE lined with a non-metallic fiberglass composite backing and shall be permanently lubricated.
- H. Actuators shall be sized to specified operating conditions. The valve actuator shall be sized to operate the valve at the rated working conditions of the valve. Each valve and valve actuator shall be assembled, adjusted, and tested as a unit per the latest revision of AWWA C504, by the valve manufacturer.
- I. Actuators with handwheel, chainwheel, and buried service nut input shall conform in all respects to AWWA C504.
- J. Coatings, unless otherwise specified, exterior and interior metallic surfaces of each valve shall be coated per the latest revision of AWWA C504. The interior of the body shall have a full rubber lining vulcanized to the valve body. Mechanical Joint valves shall be fully rubber lined to point of pipe insertion.
- K. Hydrostatic and seat leakage tests shall be conducted in strict accordance with AWWA C504

2.07 SWING CHECK VALVES

- A. Manufacturers:
 - 1. Crispin
 - 2. DeZurik
 - 3. Or approved equal

- B. The valve body shall be enlarged to allow discs to swing in the waterway. When the valve is fully open, body design shall permit a "full flow" through the valve that is equal to the nominal pipe diameter. It shall comply with AWWA Standard C-508's latest revision.
 - C. Check valve shall be rated at 250 psi water working pressure, 500 psi hydrostatic test for structural soundness. Seat tightness as rated working pressure shall be in accordance with and full conform to AWWA C-508.
 - D. Check valve shall be furnished with type of end connection as follows: 150# ANSI flanged ends.
 - E. Materials
 - 1. All ductile iron shall conform to ASTM A536 Grade 65-45-12. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Discs shall be ductile iron and rubber faced for sizes 3"-36". Hinge pins shall be 304 Stainless Steel rotating in bronze bearings. Bolts shall be electro-zinc plated steel with hex heads and hex nuts in accordance with ASTM A307 and A563 respectively.
 - F. The check valves shall be constructed to permit top entry for complete removal of internal components without removing the valve from the line. Gaskets shall be conventional in all sizes 3-36 inches.
 - G. The inside and outside of all valves, together with the working parts except bronze and machined surfaces, shall be coated in accordance with AWWA standards. All valves shall be lined and coated with minimum 8 mils DFT of NSF 61 epoxy coating.
 - H. Marking shall be in accordance with AWWA C-508 and shall include size, working pressure, and cast arrow to indicate direction of flow and name of Manufacturer.
 - I. Check valves for all pump discharge lines shall have outside spring and lever. The high point of the valve shall be tapped and provided with a stopcock for bleeding of air.
- 2.08 AIR AND VACUUM VALVES (CLEAN WATER)

- A. Manufacturers:
 - 1. Crispin
 - 2. GA Industries
 - 3. Or approved equal
- B. Air and vacuum valve shall be installed where shown on the Drawings to release the air in the main during filling, or allow it to enter the system when draining, or when the system is subject to negative pressure. The valves shall operate by sealing the Buna-N rubber outlet seat with a peripheral float as the liquid enters the valve chamber to raise the float. Valves shall be hydrostatically tested at 150% of their maximum working pressure.

- C. The valve(s) shall be constructed with a cast iron body, and top flange with stainless steel trim, and shall have an NPT screwed inlet and outlet, or ANSI Class (125, 250) flanged inlet with NPT screwed outlet. The outlet shall be 1 inch unless noted otherwise.
- D. The peripheral guided float shall be stainless steel.

2.09 HIGH VOLUME AIR RELEASE VALVES (CLEAN WATER)

- A. Manufacturers:
 - 1. GA Industries
 - 2. Or approved equal
 - a. Manufacturer shall have a minimum of ten (10) years' experience in the manufacture of automatic air valves conforming to American Water Works Association (AWWA) Standard C512 (latest revision).
- B. When requested, manufacturer shall provide detailed product data and descriptive literature including dimensions, weight, capacity, pressure rating, materials of construction and cross-sectional drawings clearly illustrating the individual components.
- C. The air release valve shall fully conform to AWWA C512 (latest revision) and suitable for use with clean water. It shall be float operated and automatically release accumulated air from the pipeline or system while in operation and under pressure.
- D. The valve connection size shall be as shown on the plans and/or in the valve schedule with NPT inlet and outlet connections and additional plugged NPT connections near the top and bottom for testing and draining. If not shown, the valve connection size to the main shall be 2-inch.
- E. High Volume Air Release Valves shall be compound lever type with adjustable seat.
- F. The valve's venting orifice diameter shall be selected for 150 PSI minimum. The valve body and cover shall be rated for 300 PSI and made from cast iron conforming to ASTM A126 Class B.
- G. The float ball, orifice and internal linkage mechanism shall be made from Type 316 stainless steel. Non-metallic components are not acceptable.
- H. The seat shall be replaceable and made from Buna-N rubber.
- I. The exterior of the valve shall be shop coated with enamel primer.
- J. When shown on the plans or in the valve schedule, the air release valve shall be fitted with a vacuum check to prevent the re-entry of air.
- K. High volume Air release valves shall be GA Industries Figures 920 VC or approved equal.

2.10 MUD VALVES

- A. Manufacturers:
 - 1. Troy
 - 2. Trumbull
 - 3. M&H
 - 4. Or approved equal
- B. The Mud Valve shall be of the heavy duty flanged type designed to provide a positive seal. The valves shall be non-rising stem style unless otherwise detailed on the schedule or the plans. The frame, plug, and yoke shall be cast iron (A126B). The seat ring shall be bronze (B62), with an accurately machined tapered seating face. The valve operating stem and lift nut shall be bronze (B421). The plug seat shall be a seamless molded, tapered resilient ring of BUNA-N, designed to accurately mate with the seat ring for a positive seal.
- C. All iron castings shall be coated with an NSF 61 approved epoxy primer.
- D. The extension stem shall be type 316 stainless steel, either solid bar or Schedule 40 pipe. The top and bottom couplings of the extension stem shall be type 316 stainless steel and not include any welded components.
- E. Where required, the manufacturer shall provide valve floor stands, and stem guides as specified in the valve schedule or indicated on the plans.
- F. Mud Valves shall be recessed as required to top of valve flange is flush with the top of slab.

2.11 SOLENOID VALVES

- A. Manufacturers:
 - 1. Hayward Industrial Products.
 - 2. Or equal
- B. Solenoid valves shall be normally closed, slow closing, and shall open wide to permit full pipe opening when the solenoid is energized and closed tight when the solenoid is de-energized. All parts in contact with the fluid being handled shall be of corrosion resistant construction. Coils shall be rated 120 V, 1 phase, 60 Hz continuous duty and shall be completely encapsulated in epoxy resin.

2.12 REDUCED PRESSURE ZONE BACKFLOW PREVENTER

- A. Manufacturers:
 - 1. Apollo model RPLF 4A
 - 2. Or approved equal

- B. The reduced pressure principle backflow preventers shall consist of two independently acting, center stem guided check valves with a differential pressure relief valve located between the check valves, designed to give maximum protection against backflow of fluids by either back-pressure or back-siphonage.
 - 1. 2-1/2"-8" valve bodies shall be manufactured of domestic stainless steel
 - 2. 10" & 12" valve bodies shall be ductile iron units, easily maintained in the line without any special tools. check valves shall operate with a spring assist to provide high flow rates.
 - 3. Maximum working pressure shall be 175 psi.
- C. Unit shall come pre-plumbed and configured with wye strainer, handwheel operated gate valves, integral check valves and pressure reducing valve as one unit.

2.13 BALL VALVES

- A. Manufacturers:
 - 1. Apollo model 96-100
 - 2. Or approved equal
- B. Ball valves shall be stainless steel in construction, uni-body, with reinforced seats and seals, blowout-proof stem and adjustable packing gland.
 - 1. 1/4" – 2" valve bodies shall be manufactured of domestic stainless steel
 - 2. PTFE Trim

2.14 HYDRANTS

- A. The Contractor shall furnish and install fire hydrants as indicated on the Drawings, as listed in the Proposal, and as specified herein. All fire hydrants shall meet the requirements of the American Water Works Association Specification C502 latest revision.
- B. Manufacturers:
 - 1. Mueller "Super Centurian"
 - 2. M&H Model 929
 - 3. Or approved equal
- C. Connections:.
 - 1. Main valve opening shall not be less than 5-1/4"
 - 2. Two 2-1/2" hose nozzle connection
 - 3. Threads shall be National Standard

4. Shoe Connection shall be 6" furnished with mechanical joint for connection to spigot of mechanical joint hydrant lead.

D. General Construction:

1. Hydrants shall be compressive type, self-oiling, non-freezing and shall be provided with a safety flange and coupling.
2. The operating unit shall be totally sealed away from the hydrant barrel and all working parts shall be continuously and automatically lubricated from a large oil or grease reservoir and packing gland. Drain mechanism shall be simple, positive and automatic in operation.
3. The safety flange on the barrel and safety coupling on valve stem shall operate to prevent damage to barrel and stem in case of a traffic accident. The force of the impact shall break the flange and spread the coupling. The construction of the flange and coupling shall be so constructed as to permit facing nozzles in any direction at any time without digging or cutting off water by removing safety flange bolts and revolving the head.
4. All working parts of the hydrant, including the seat ring, shall be removable through the top without digging. Seat rings shall be so shaped and arranged to be readily removable. Seat rings shall be bronze and shall screw into a bronze drain ring or bushing in the shoe. An O-ring seal between the shoe and seat ring shall provide a watertight non-wearing, permanent seat between shoe and seat ring. This seal shall always come out with main valve removal.
5. Hose connections shall be either threaded or locked in place or breech-locked into the hydrant barrel and then caulked with lead to seal them permanently.

2.15 YARD HYDRANTS

- A. Wall hydrants shall be cast brass, non-freeze with 1" HPT outlet, T-handle, polished face, brass wall casing, renewable nylon seat, and brass operating parts. Wall hydrants shall be Josam Model 71000-8, Wade Model W8600L6+2, or equal.

2.16 HOSE BIBS AND HOSES

- A. Hose bibs shall be as detailed on the drawings and shall be ¾", non-freeze type with brass casings and T-handle. Furnish 1 quick female coupling hose fitting for each hose bib.
- B. Hose shall be 1" I.D. reinforced rubber discharge hose. The hose shall provide high resistance to abrasion, aging and weathering. All hose materials shall be mildew and moisture resistant. Hoses shall remain flexible under all conditions. Provide four 50' long hoses for the proposed SBRs, one 50' hose for the proposed digester and two hoses for the sludge dewatering building. Hose couplings shall be compatible with supply connection and nozzles. Couplings adapters shall be provided where necessary. Hose shall be Goodyear Plicord, Eaton or equal.

1. Nozzles: Each hose shall be provided with a nozzle. Nozzles shall be rugged brass of the combination fog and straight stream type. The nozzle stream shall be adjustable for washing tank walls. The nozzle shall have stream-shaping teeth for even flow distribution.
2. Hose Reels: Hose reels shall be provided for each hose. Hose reels shall be provided with a hand crank. The hose reel shall be capable of containing the entire length of hose specified. Where structure has more than 3' of exposed concrete above grade, provide Hannay hose reel Series 7500 for mating to concrete structure wall. Where structure has less 3' of exposed concrete above grade, provide Hannay Series AT1200 and provide 1" hoses with transition couplings for source connections. For site hose reels provide Coxreels Model SLPL-750 or equal.

2.17 COATINGS

- A. Provide the factory applied coating listed above, where a coating system is not specified provide a factory applied primer compatible with painting systems specified in the Painting Section 09 91 00.
- B. A field applied finished coating shall be applied to the valves per Painting Section 09 91 00 and Identification for Process Piping Section 40 05 95.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Install all valves in strict accordance with the Drawings, approved shop drawings, and the manufacturer's instructions.
2. Install valves in a manner that ensures operators and packing are easily accessible. Valves with field-replaceable seats must be installed with sufficient clearance to allow for the removal of the valve bonnet and stem without needing to remove the valve from the pipeline.
3. Coatings:
 - a. After installation and acceptance testing by the Engineer, apply touch-up paint to all scratched, abraded, and damaged surfaces on the shop-painted areas. The coating type and color shall match the original shop painting.

END OF SECTION

SECTION 40 05 57

ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. This section includes electric motor actuators for valves and gates.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 40 05 51 - Common Requirements for Process Valves
 - 2. Section 26 05 00 - Common Work Results for Electrical

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
 - 1. BS EN 15714-2 -Industrial valves. Actuators. Electric actuators for industrial valves
- B. American Water Works Association (AWWA):
 - 1. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates
- C. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA 250 - Enclosures for Electrical Equipment
 - 2. NEMA ICS 6 - Industrial Control and Systems Enclosures
- D. International Electrotechnical Commission (IEC):
 - 1. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code)
- E. International Society of Automation (ISA)
 - 1. ISA96.02 - Electric Actuators

1.04 SUBMITTALS

- A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
- B. Product Data:
 - 1. Cutsheets and catalog information for the following: manufacturer's literature, illustrations, specifications, and engineering data to include materials of construction, dimensions,

performance data and curves, electrical characteristics, control interface details, and torque calculations.

C. Shop Drawings:

1. The shop drawings shall include installation drawings, operator mounting details and wiring diagrams for electric operators.

D. Quality Assurance/Control Submittals:

1. Material compliance certificates
2. Factory test reports

E. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The manufacturer must operate an ISO 9001 certified facility with at least ten years of experience in installations for the specified service.

B. Testing Requirements:

1. Manufacturer's performance test.

1.06 WARRANTY

1. Provide a warranty against defective materials and workmanship in accordance with the manufacturer's standard warranty minimum two (2) years from date of shipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:

1. Rotork IQ/IQT Series
2. Limitorque MX/QX Series
3. Or approved equal

2.02 GENERAL REQUIREMENTS

- A. The actuators shall be suitable for use on a nominal 480volt, 3 phase, 60 Hz power supply except quarter-turn valves 16 inch and smaller which shall operate on 120 volt, single phase, 60 hertz power, and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.
- B. As a minimum the actuators should meet the requirements set out in AWWA C542, EN15714-2 and ISA SP96.02

- C. In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. must be carried out without the removal of any actuator covers and without mains power over an Infrared or Bluetooth® wireless interface. Sufficient commissioning tools must be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools must not form an integral part of the actuator and must be removable for secure storage / authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool. Provision shall be made to disable Bluetooth® communications or only allow a Bluetooth® connection initiated by an Infra-Red command for maximum security.
- D. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.
- E. The actuators shall incorporate a motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure. Setting of the torque levels, position limits and configuration of the indication contacts etc. shall be performed by Infra-red or Bluetooth® wireless interface without the removal of any actuator covers and without the need of supply power. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel regardless of the connection sequence of the power supply.

2.03 ACTUATOR SIZING

- A. The actuator must be sized to guarantee valve closure at the specified differential pressure and temperature. The safety margin of motor power available for seating and unseating the valve must be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the data sheet. For 90° valve types the operating time will be specified.

2.04 ENVIRONMENTAL

- A. Actuators must be suitable for indoor and outdoor use with a standard corrosivity category, C4 medium durability as per ISO 12944. The actuator must be capable of functioning in an ambient temperature ranging from -22°F to +158°F, up to 100% relative humidity. Actuators for hazardous area applications must meet the area classification, gas group and surface temperature requirements specified in the data sheet.

2.05 ENCLOSURE

- A. Actuators shall be O-ring sealed, watertight to IP66/IP68 20m for 10 days, NEMA 4, 6. The motor and all other internal electrical elements of the actuator must be protected from ingress of moisture and dust when the terminal cover is removed for site cabling. The terminal compartment must maintain the same ingress protection rating with the terminal cover removed. The actuator enclosure must allow for temporary site storage without the need for electrical supply connection. All external fasteners shall be suitable for the actuator corrosivity category and installation environment indicated on the datasheet.

2.06 MOTOR

- A. The motor must be an integral part of the actuator, designed specifically for valve actuator applications. The motor shall be a low inertia, high torque design and class F insulated. Resulting

in class B temperature rise with a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Temperature shall be limited by thermostat device embedded in the motor end windings and integrated into the actuator control. Electrical and mechanical disconnection of the motor shall be possible without draining the lubricant from the actuator gearcase. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

2.07 MOTOR PROTECTION

A. Protection must be provided for the motor as follows:

1. Stall - the motor must be deenergized within 8 seconds in the event of a stall when attempting to unseat a jammed valve.
2. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling
3. Single phasing - lost phase protection.
4. Direction – phase rotation correction.

2.08 GEARING

A. The actuator gearing must be totally enclosed in an oil-filled gearcase suitable for operation at any angle. Grease lubrication is not permissible. All drive gearing and components must be of metal construction and incorporate a lost-motion hammer blow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gearcase for inspection or disassembled without releasing the stem thrust or taking the valve out of service. For 90° operating type valves, drive gearing shall be self-locking to prevent the valve back-driving the actuator.

2.09 HAND OPERATION

- A. A handwheel must be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to electrical operation automatically by starting the motor. The handwheel or selection lever must not move on restoration of motor drive. Provisions shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.
- B. Clockwise operation of the handwheel must give closing movement of the valve unless otherwise stated in the data sheet. For linear valve types the actuator handwheel drive must be mechanically independent of the motor drive and should be such as to permit valve operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating/unseating of the valve.

2.10 DRIVE INTERFACE

A. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. The drive bush shall be positioned in the base of the actuator.

Thrust bearings shall be sealed for life and the base shall be capable of withstanding five times the rated thrust of the actuator.

2.11 LOCAL CONTROLS

- A. The actuator must incorporate local controls for Open, Close and Stop operation and a Local/Stop/Remote mode selector switch. Mode selection must be lockable in any one of the following three positions: local control plus local stop only, stop (no electrical operation), remote control plus local stop only. It must be possible to select maintained or non-maintained local control.
- B. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.
- C. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

2.12 TORQUE AND LIMITS

- A. Torque and turns limitation to be adjustable as follows:
 - 1. Position setting range – multi-turn: 2.5 to 8,000 turns, with resolution to 7.5° of actuator output.
 - 2. Position setting range – direct drive part turn actuators: 90° +/-10°, with resolution to 0.1° of actuator output.
 - 3. Torque setting: 40% to 100% rated torque.
- B. Position measurement – Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred.
- C. Measurement of torque for multi-turn actuators must be from direct measurement of force at the output of the actuator. Methods of determining torque-using data derived from the motor such as motor speed, current, flux etc. are only acceptable for part-turn actuators.
- D. A means for automatic “torque switch bypass” to inhibit torque off during valve unseating and “latching” to prevent torque switch hammer under maintained or repeated control signals shall be provided.
- E. The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

2.13 REMOTE VALVE POSITION AND STATUS INDICATION

- A. Four contacts must be provided, which can be selected to indicate any position of the valve; Provision must be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.

- B. The contacts must be rated 5mA to 5A, 120V AC, 30V DC.
 - C. As an alternative to providing valve position indication, any of the four contacts shall be selectable to signal one of the following:
 - 1. Valve opening, closing or moving
 - 2. Thermostat tripped, lost phase
 - 3. Motor tripped on torque in mid travel, motor stalled
 - 4. Remote selected, Local selected, Stop selected
 - 5. Actuator being operated by handwheel
 - 6. Actuator fault
 - D. Provision shall be made in the design to support an additional eight contacts with the same configurable functionality.
 - E. A configurable monitor relay must be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal block.
 - F. Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel and / or torque for remote indication when required. The transmitter will auto range to the set limits.
- 2.14 LOCAL POSITION INDICATION
- A. The actuator display must include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display must be backlit to enhance contrast at all ambient light levels and must be legible from a distance of at least 5m (16ft). A power save mode shall be available to switch off the display backlight during long periods of inactivity.
 - B. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions must be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display must be maintained and updated during handwheel operation when mains power to the actuator is isolated.
 - C. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator.
 - D. Datalogger graphical displays and trend graphs must be available on the local LCD for the following functions:
 - 1. Torque versus Position

2. Number of Starts versus Position
 3. Number of starts per hour
 4. Dwell Time
 5. Average temperature
- E. The main display must include configurable a minimum of four different home-screens that include the following information:
1. Position and status
 2. Position and torque (analogue)
 3. Position and torque (digital)
 4. Position and demand (positioning)
- F. An optional environmental cover to protect the display from high levels of UV radiation or abrasive materials must be available and shall be fitted without the need for any special tooling.
- G. The local controls and display must be rotatable through increments of 90 degrees to suit valve and actuator installation orientation.
- 2.15 INTEGRAL STARTER AND TRANSFORMER
- A. The reversing starter, control transformer and local controls must be integral to the valve actuator and suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour during normal service or 1,200 starts per hour under reduced load conditions and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It must have the necessary voltage tapping and be adequately rated to provide power for the following functions:
1. Energizing of the contactor coils
 2. 24V DC or 110V AC output for remote controls (maximum 5W/VA)
 3. Supply for all the internal electrical circuits
- B. An alternative solid state motor starter is permissible for applications requiring up to 1,200 starts per hour. 24VDC remote controls should be used in combination with a solid state starter to maximise response time. The solid state starter must facilitate configurable electrical braking functionality.
- C. Speed adjustable actuators must have an integral motor controller to manage starting, speed and operation.
- 2.16 REMOTE CONTROL FACILITIES
- A. The necessary control, wiring and terminals must be contained within the actuator enclosure. Open and close external interlocks must be made available to inhibit local and remote valve opening / closing control. It must be possible to configure the interlocks to be active in remote control only.

- B. Remote control signals fed from an internal 24VDC (or 110VAC) supply and/or from an external supply between 20V and 60VDC or 40V and 120VAC, must be suitable for any one or more of the following methods of control:
 - 1. Open, Close and Stop control
 - 2. Open and Close maintained or “push to run” (inching) control
 - 3. Overriding Emergency Shut-Down; to close (or open) valve from a normally closed or open contact
 - 4. Two-wire control; energise to close (or open), de-energise to open (or close)
- C. Additionally, provision shall be made for a separate ‘drive enable’ permissive input to prevent any unwanted electrical operation.
- D. It must be possible to reverse valve travel without the necessity of stopping the actuator or moving through an intermediate stop control position. The motor starter must be protected from excessive current surges during rapid travel reversal. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses up to 2kV.
- E. Operation by distributed control system must be possible utilising one or more of the following network systems:
 - 1. Profibus
 - 2. Modbus
 - 3. Foundation Fieldbus
 - 4. DeviceNet
 - 5. Pakscan
 - 6. HART

2.17 MONITORING FACILITIES

- A. Facilities to indicate actuator availability and monitor operation must be included as standard.
- B. Actuator text display indication of the following status/alarms:
 - 1. Closed Limit, open limit, moving open, moving closed, stopped
 - 2. Torque trip closing, torque trip opening, motor stalled
 - 3. ESD active, interlock active
 - 4. Thermostat trip, phase lost, 24V supply lost, local control failure
 - 5. Configuration error, position sensor failure, torque sensor failure
 - 6. Battery low, battery discharged, power loss inhibit
- C. Integral datalogger to record and store the following operational data:

1. Opening last / average torque against position
2. Closing last / average torque against position
3. Opening motor starts against position
4. Closing motor starts against position
5. Total open / closed operations
6. Maximum recorded opening and closing torque values
7. Event recorder logging operational conditions (valve, control and actuator)

D. The event log must include time and date information for each stored event.

E. Logged data must be accessible via non-intrusive Bluetooth® communication and also visible on the actuator display. An intrinsically safe portable tool must be provided to extract datalogger and actuator configuration files from the actuator. The portable tool must permit Bluetooth® connection with a PC to perform file transfer. The actuator manufacturer must supply PC software to enable extracted actuator files to be viewed and analyzed.

2.18 WIRING AND TERMINATION

A. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and power. Each wire shall be clearly identified at both ends. The terminals shall be embedded in a terminal block of high tracking resistance compound.

B. The terminal compartment must be separated from the inner electrical components of the actuator by means of a watertight seal. A minimum of four threaded cable entries with provision for an additional four extra conduit entries must be available to accommodate wiring connections.

C. All wiring supplied as part of the actuator must be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable. A durable terminal identification card showing a plan of terminals must be attached to the inside of the terminal box cover indicating:

1. Serial number
2. External voltage values
3. Wiring diagram number
4. Terminal layout

D. The code card must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Install all valves in strict accordance with the Drawings, approved shop drawings, and the manufacturer's instructions.
2. Install valve actuators in a manner that ensures easily accessible for maintenance.

B. Electrical:

1. Verify power requirements, install conduit and wiring, ground according to codes and terminate all connections.
2. Provide all labor, materials, tools, equipment, and services necessary to integrate the electric valve actuators into the plant instrumentation and control system, ensuring full system functionality.

3.02 STARTUP AND SERVICE

A. Provide manufacturer's Field Service Technician for a minimum of one 4-hour day on site. The Field Service Technician shall:

1. Verify the installation is in accordance with the Drawings, Specifications, and manufacturer's instructions
2. Calibrate and check all installed equipment
3. Perform initial start-up
4. Make all required tests, adjustments, and related items to ensure the valve actuators are performing and operating as specified
5. Train operators in daily operational procedures, operation & maintenance, and troubleshooting.

B. As needed the Contactor shall schedule site visits with the Field Service Technician to ensure proper installation of equipment, structures, and facilities with no additional cost to the Owner,

3.03 COMMISSIONING KIT

A. Each actuator must be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

3.04 PERFORMANCE AND TEST CERTIFICATE

A. Each actuator must be performance tested by the manufacturer and individual test certificates are to be supplied free of charge. Test certificates must be retained by the manufacturer for the serviceable life of the product. The test certificate must include details of the equipment specification such as:

1. Serial number
2. Test date
3. Manufacturing site address

4. Customer
 5. Customer order number (where applicable)
 6. Actuator size
 7. Mounting flange
 8. Enclosure type
 9. Lubricant
 10. Paint coating
 11. Power supply
 12. Operating speed/time
 13. Drive close direction
 14. Gear ratio for second stage gearbox (where applicable)
 15. Electrical optional extras
 16. Catalogue performance
- B. The test equipment should simulate a typical valve load. The following parameters must be recorded and clearly stated on the certificate:
1. Torque at maximum torque setting in both directions
 2. Current at maximum torque setting in both directions
 3. Flash test statement
 4. Test power supply voltage

END OF SECTION

SECTION 40 05 59
HYDRAULIC GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements for hydraulic gates including:
 - 1. Stainless-steel sluice gates
 - 2. Stainless-steel slide gates
 - 3. Stainless-steel weir gates
- B. The gates shall be provided as specified and as shown or scheduled in the Contract Documents.
- C. The gates shall be in compliance with the latest version of AWWA C561 as modified herein.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 03 62 00 – Non-Shrink Grouting
 - 3. Section 09 91 00 - Painting
 - 4. Section 40 05 00 - Common Work Results for Process Interconnections
 - 5. Section 40 05 57 - Actuators for Process Valves and Gates

1.03 REFERENCES

- A. American Water Works Association (AWWA)
 - 1. AWWA C561 - Fabricated Stainless-Steel Slide Gates.
 - 2. AWWA C541 - Hydraulic and Pneumatic Cylinder Actuators for Valves and Slide Gates
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 2. ASTM A276 - Standard Specification for Stainless Steel Bars and Shape
- C. NSF International

1. NSF 61 - Drinking Water System Components
2. NSF 372 - Drinking Water System Components - Lead Content

1.04 SUBMITTALS

- A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00
- B. Shop Drawings:
 1. Submittals shall include, at a minimum, detailed custom drawings of the gate assembly with dimensional and mounting information and a listing of the materials of construction. General arrangement drawings and cut sheets are not considered acceptable drawings.
- C. Product Data
 1. Cutsheets and catalog information for the following: manufacturer's literature, illustrations, specifications, and engineering data to include materials of construction, dimensions and weights, pressure ratings, flow characteristics and valve operator details.
 2. Calculations shall be provided to confirm compliance with the safety factors listed in AWWA C561 for all parts of the frame, anchorage and slide including the portion of the slide that engage the frame.
- D. Quality Assurance/Control Submittals
 1. A copy of the test results from the minimum 30,000 cycle test confirming the durability of the seal system.
 2. A copy of the ISO 9001:2015 certification.

1.05 DEFINITIONS

- A. Stainless-steel sluice gates: A heavy-duty gate with a four-sided seal system that is used to close off an orifice that experiences a maximum water level that can exceed the top of the orifice.
- B. Stainless-steel slide gates: A gate that has a three-sided seal system. The seals are positioned along the sides and across the invert of the opening.
- C. Stainless-steel weir gates: A downward-opening slide gate.

1.06 PERFORMANCE REQUIREMENTS

- A. Leakage for stainless steel gates shall be restricted to 0.05 gpm/ft or less of the seal perimeter at the design seating head and the design unseating head.

1.07 QUALITY ASSURANCE

- A. All gates shall be shop inspected for proper operation prior to shipment.
- B. Welds shall be performed by welders with ASME Section IX or AWS D1.6 certification.
- C. The gate manufacturer shall be ISO 9001:2015 certified.

PART 2 - PRODUCTS

2.01 STAINLESS STEEL SLUICE, SLIDE, AND WEIR GATES

A. Manufacturer

1. The basis for the design of the sluice gates and slide gates is Model RW1000-S as manufactured by RW Gate Company, Troy, NY. Equal products from other manufacturers will be accepted with prior approval.

B. Materials of Construction

1. All stainless steel referenced in this specification shall be Type 304, ASTM A240 or ASTM A276 unless otherwise indicated herein.
 - a. All welded stainless steel components shall be constructed of Type 304L stainless steel.
 - b. All structural stainless steel used in the construction of slides and frames shall have a minimum material thickness of 1/4-inch.
 - c. All non-welded stainless steel components, excluding anchor bolts and assembly bolts, shall be Type 304 or Type 304L stainless steel.
 - d. Anchor bolts and assembly bolts shall be Type 316 stainless steel.

C. Slide

1. The slide shall consist of a stainless steel plate that is reinforced with stiffeners to withstand the specified head conditions. The slide shall engage the frame a minimum of 1-inch on each side.
 - a. The slide shall be reinforced with plates or channel shaped members to restrict deflection to 1/16-inch or less at the design head.
 - b. The stiffeners shall be welded to the slide plate in the horizontal and vertical positions.
 - c. The portion of the slide that engages the frame shall have a minimum thickness of 1/2-inch.
 - d. On rising stem gates, a stem connector shall be welded to the slide as a means of connecting the operating stem. The bottom portion of the stem shall be affixed to the stem connector with a minimum of two attachment bolts.
 - e. On non-rising stem gates, the slide shall be arranged to allow travel of the stem along the length of the slide.

D. Frame

1. The frame shall be constructed of stainless steel plate, with the guide section formed into a C channel shape or similar to house the seal, and shall be reinforced to withstand the specified operating conditions.

- a. The guides shall be of a one-piece design with gussets that extend along the outside and top to accommodate unseating head. The guide members shall incorporate a tubular cross section along the guides for additional rigidity. Two-piece, sandwich type guides that are bolted together are not acceptable.
- b. The mounting configuration of the frame shall be as shown on the Contract Drawings.
- c. Wall mounted frames shall be of the flanged frame type. Flat frames shall only be provided on gates with frames that will be embedded in the concrete wall or mounted inside existing channels.
- d. The guide portion of flanged frame gates shall have a minimum weight of 13 lbs/ft. The guide portion of the flanged frame, where the anchors penetrate, shall have a minimum thickness of 1/2-inch.
- e. The guide extension portion of the frame shall have a minimum weight of 6 lbs/ft. Angles are not considered acceptable guide extensions.
- f. Lifting lugs shall be provided on all frame styles.
- g. On self-contained gates, the side frame shall extend above the operating floor and the operating mechanism shall be mounted to the yoke. When shown, the frame may extend to or below the operating floor and a floorstand may be mounted on the yoke.
- h. Yoke members shall be C channel shaped structural members. Angles are not considered acceptable yoke members.

E. Seals

- 1. The seal system shall consist of self-adjusting UHMWPE seals with a nitrile or EPDM compression cord.
 - a. The UHMWPE seals shall be arranged to ensure that there is no metal-to-metal contact between the slide and frame.
 - b. The compression cord shall be contained by the UHMWPE seal so that it shall not be in contact with the slide.
 - c. Seal system shall be self-adjusting for the life of the gate. Adjustable wedging devices such as wedges, wedge bars and pressure pads are not acceptable.
 - d. On upward-opening gates, rubber side seals and/or top seals such as J-bulb seals or similar rubber seals are not acceptable in lieu of UHMWPE seals.
 - e. On downward opening gates, rubber side seals and/or invert seals such as J-bulb seals or similar rubber seals are not acceptable in lieu of UHMWPE seals.
 - f. The invert seal on upward opening gates shall use a compressible EPDM seal located in the invert of the frame.
 - 1) The invert seal shall be of a flush bottom arrangement.
 - 2) The invert seal shall be mechanically fastened with stainless steel bolts.

- 3) Invert seals attached solely by the use of adhesives are not acceptable.
- g. All seats and seals shall be secured with assembly bolts. All seals shall be field removable and field replaceable without the need to remove the gate frame from the wall. Gates that require disassembly of any portion of the frame, to replace seals, are unacceptable.
- h. Anchor bolts shall not penetrate the seats or seals and anchor bolts shall not prevent the removal or replacement of seats or seals.
- i. The seal system shall have been shop tested with a minimum 30,000 cycle operating test in an abrasive environment to confirm the ability of the seals to withstand the abrasive condition with negligible deterioration and to confirm that the leakage restriction requirement is still possible.
 - 1) The shop test shall have been performed on a stainless steel sluice gate and the test results shall have been certified by the manufacturer in writing.
 - 2) A copy of the test shall be provided to the Engineer.

F. Operating Stem

- 1. The operating stem shall be of stainless steel and shall be designed to transmit in compression at least 2 times the rated output of the manual operating mechanism with an 80 lbs effort.
- 2. The stem shall have a slenderness ratio (L/r) less than 200.
- 3. The threaded portion of the stem shall have a minimum diameter of 1-1/2 inches.
 - a. The threads shall have machine rolled, full depth ACME threads.
 - b. Stub threads are not acceptable.
- 4. Stems provided in multiple pieces shall be provided with couplings.
 - a. Couplings shall be bronze or stainless steel and shall be internally threaded and keyed or bored and bolted.
- 5. Stem guides shall be constructed of stainless steel with UHMWPE bushings.
- 6. Gates with rising stems shall be provided with a clear plastic stem cover.
 - a. The stem cover shall be butyrate and shall have a cap and condensation vents.
 - b. Clear mylar indicating tape shall be provided for field application after the gate has been installed and positioned.
 - c. Unless noted otherwise, provide gates with rising stems.
- 7. Stop collars shall be provided to limit the downward travel on gates with manual operating mechanisms.
 - a. Stop collars shall be bronze and shall be internally threaded and provided with a stainless steel set screw.

G. Operating Mechanism

1. Operating mechanisms shall be provided by the gate manufacturer.
2. Manual operators shall be yoke mounted on self-contained gates or floorstand mounted when shown in the Contract Documents.
 - a. Manual operators shall be of the bevel gear type suitable for operation with a portable operator.
 - b. Gear ratios shall be selected by the gate manufacturer to ensure that the maximum operating effort is 40 lbs at the design head.
 - c. Minimum gear ratio shall be 2:1.
 - d. Gearboxes shall have ductile iron housings, a bronze lift nut, steel gears and a stainless steel input shaft.
 - e. Ball or roller bearings shall support the lift nut and input shaft.
 - f. The housing shall be grease lubricated and permanently sealed.
 - g. Handwheels or cranks shall be provided. Handwheels shall be constructed of epoxy-coated steel or stainless steel and shall have a maximum diameter of 24 inches. Cranks shall be constructed of stainless steel and have a maximum length of 15 inches.
 - h. Adaptor plates shall be utilized to attach the operating mechanism to the yoke. Adaptor plates shall be stainless steel and shall have a minimum thickness of 3/4-inch.
3. Interconnected gearboxes and multiple stems shall be provided to ensure proper operation of wide gates.
 - a. Interconnected gearboxes are required on all upward opening gates when the opening width is greater than 60 inches and the height of the slide is less than half of the width.
 - b. Interconnected gearboxes are required on all downward opening gates when the opening width is greater than 48 inches and the height of the slide is less than half of the width.
 - c. Interconnected gearboxes shall consist of a stainless steel interconnecting shaft with flexible couplings on each end and stainless steel hardware. Aluminum shafts are not acceptable.
 - d. Gates with interconnected gearboxes, driven by an electric motor operator, shall be provided with a shroud to cover the interconnecting shaft.
 - 1) The shroud shall be removable.
 - 2) The shroud shall be constructed of stainless steel and shall have a minimum thickness of 20 gauge.

H. Floorstands and Wall Brackets

1. Floorstands shall be mounted to the concrete, mounted to a wall bracket or mounted on the yoke of a self-contained gate as shown on the Contract Drawings.
2. All floorstands and wall brackets shall be fabricated from stainless steel.
 - a. The base plate, adaptor plate and gussets shall be minimum 1/2-inch thick.

I. Anchorage

1. Anchor bolts for the gate assembly and appurtenances shall be provided by the gate manufacturer.
 - a. The anchor bolts shall be 316 stainless steel, fully threaded and shall have a minimum diameter of 1/2-inch.
 - b. Anchor bolts shall be of the epoxy type.

J. Finish

1. All heat tint and slag from the welding process shall be passivated in accordance with ASTM A380. If bead blasting is used, the entire slide and entire frame shall be bead blasted.
2. All ferrous components shall be suitably prepared and then shop coated with primer. Finish coating shall be applied by the Contractor. The ductile iron operator housing shall be finish coated and/or provided with touch-up paint by the Contractor with a suitable paint that complies with Section 09 91 00, Painting.

PART 3 - EXECUTION

3.01 INSTALLATION OF STAINLESS-STEEL SLUICE, SLIDE, AND WEIR GATES

- A. Installation shall be performed in accordance with the gate manufacturer's installation instructions and the approved installation drawings.
- B. Installation instructions and installation drawings shall be found in the O&M manual.
- C. Non-shrink grout shall be applied, by the Contractor, between the gate frame and the wall to ensure that there is no leakage around the gate. A 1-inch thick grout pad shall be provided as shown on the installation drawings.

3.02 SCHEDULE OF GATES:

GATE ID	LOCATION	TYPE	DESCRIPTION
G-1	Rapid Mix Effluent	SS Slide Gate	27" (H) x 36 (W) Opening
G-2	Rapid Mix Effluent	SS Slide Gate	27" (H) x 36 (W) Opening
G-3	Rapid Mix Effluent	SS Slide Gate	27" (H) x 36 (W) Opening
G-4	Rapid Mix Effluent	SS Slide Gate	27" (H) x 36 (W) Opening
G-5	Rapid Mix Chamber	SS Sluice Gate	Non rising stem 24" Square Slide
G-6	Clearwell	SS Sluice Gate	36" Square Opening
G-7	Clearwell	SS Sluice Gate	36" Square Opening
G-8	Clearwell	SS Sluice Gate	24" Square Opening
G-9	Clearwell	SS Sluice Gate	24" Square Opening

3.03 FIELD SERVICE

- A. A service technician shall be provided to instruct the Contractor prior to the installation of the first gate. The service technician shall be available for one (1) 8-hour work-day at the project site.
- B. If electric actuators are provided, a second trip will be provided to set the limit switches on the electric actuators.

END OF SECTION

SECTION 40 05 97

IDENTIFICATION OF PROCESS PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This section covers common requirements for identifying process piping and equipment.
- B. The work includes
 - 1. Color coding of all process piping
 - 2. Labeling of pipes with content descriptions and flow direction indicators.
 - 3. Identification of equipment, valves, pumps, and instrumentation
 - 4.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 09 91 00 – Paints and Coatings
 - 3. Section 40 05-00 – Common Results for Process Piping
 - 4. Section 40 05 51 – Common Requirements for Process Valves
 - 5. Division 46 – Water and Wastewater Equipment

1.03 REFERENCES

- A. Recommended Standards for Water Works (Ten State Standards) – Latest edition
- B. ANSI/ASME A13.1-2015, Scheme for the Identification of Piping Systems

1.04 SUBMITTALS

- A. Product Data: Submit product data for all piping materials in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
- B. Submit labeling layouts and color schedule

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original packaging. Store in dry, protected area to prevent fading or damage

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Pipe Color Coding: Pipe shall be painted in accordance with the systems specified in Section 09 91 00.
- B. Labels:
1. Stenciled Painting
 2. Engraved phenolic, laminated plastic, or pressure-sensitive vinyl markers, weather-resistant, with flow arrows. Include pipe contents (e.g., "Raw Water") and direction of flow.
 3. Letter Sizing: The size of lettering shall be as follows:

<i>Outside Diameter of Pipe or Covering</i>	<i>Size of Letters</i>
¾" to 1¼"	½"
1½" to 3"	¾"
3¼" to 4¼"	1"
4½" to 6¾"	1½"
7" to 7¾"	2"
8" to 9¾"	2½"
10" to 11¾"	3"
12" and over	3½"

- a. For pipes smaller than ¾" in outside diameter, use laminated plastic or aluminum tag with the lettering etched or stamped and filled in with black or contrasting enamel
- C. Equipment Tags: Stainless steel or aluminum, etched or stamped and filled with black or contrasting enamel, minimum 2 x 4 inches (50 x 100 mm), with chain or wire attachment. Include equipment tag number, service description, and capacity/rating.
- D. Valve Tags: Metal tags with chain, stamped with valve number, function (e.g., "Isolation Valve"), and location reference.
- E. Safety Signs: As required by OSHA 29 CFR 1910.145 for hazards (e.g., chlorine areas)

PART 3 - EXECUTION

3.01 PIPE COLOR CODING:

- A. To facilitate identification of piping, the following color scheme shall be utilized in accordance with the "Ten State Standards"

Service	Type	Color	Tnemec Color Code
Water	Raw or Recycle	Olive Green	110GN Clover

Service	Type	Color	Tnemec Color Code
Water	Settled or Clarified	Aqua	10GN Aqua Sky
Water	Finished or Potable	Dark Blue	11SF True Blue
Water	Nonpotable Water	Blue (Black Band)	11SF True Blue (35GR Black)
Chemical	Alum	Orange	04SF Tangerine Orange
Chemical	Ammonia	White	00WH White
Chemical	Carbon Slurry	Black	35GR Black
Chemical	Caustic	Yellow (Green Band)	02SF Lemon Yellow (09SF Spearmint Green)
Chemical	Chlorine (Gas & Solution)	Yellow	02SF Lemon Yellow
Chemical	Fluoride	Light Blue (Red Band)	25BL Fountainbleu (06SF Candy Apple Red)
Chemical	Lime Slurry	Light Green	37GN Irish Spring
Chemical	Ozone	Yellow (Orange Band)	02SF Lemon Yellow (04SF Tangerine Orange)
Chemical	Phosphate Compounds	Light Green (Red Band)	37GN Irish Spring (06SF Candy Apple Red)
Chemical	Polymer & Coagulant Aids	Orange w/ (Green Band)	04SF Tangerine Orange (09SF Spearmint Green)
Chemical	Potassium Permanganate	Violet	14SF Purple Rain
Chemical	Soda Ash	Light Green (Orange Band)	37GN Irish Spring (04 SF Tangerine Orange)
Chemical	Sulfuric Acid	Yellow (Red Band)	02SF Lemon Yellow (06SF Candy Apple Red)
Chemical	Sulfur Dioxide	Light Green (Yellow Band)	37GN Irish Spring (02SF Lemon Yellow)
Waste Lines	Backwash Waste	Light Brown	68BR Twine
Waste Lines	Sludge	Dark Brown	84BR Weathered Bark
Waste Lines	Sewer (Sanitary or Other)	Dark Gray	33GR Gray
Other	Compressed Air	Dark Green	91GN Balsam
Other	Gas	Red	06SF Candy Apple Red

3.02 PIPE LABELS

- A. After other painting of pipe work has been completed as provided in Section 09 91 00 and scheduled above, the Contractor shall label the pipe work by stenciled legends or as ordered by the Engineer.
- B. In addition to the color coding of piping, two legends descriptive of the function of the pipe, such as "Sludge" or "Filtered Water" shall be stenciled. One legend shall be stenciled on each side of the pipe on the pipe lines, and on the side of the bands away from the valve or fittings. The legend shall be located on the pipe so that it will be in direct line of vision. Legend may be omitted from one side if view is obstructed from that side. Where the flow in a pipe shall be at all times in one direction only, then a flow arrow shall be placed in front of each legend on the pipe. The lettering and arrows shall be cut neatly into stencils, the arrows being the same height as the letters.
- C. The legends and flow arrows shall be stenciled with approved black or contrasting stencil paint.

3.03 EQUIPMENT LABELS

- A. The Contractor shall paint stencil lengths in the same manner as a pipe of appropriate size on the individual units of equipment such as blowers, pumps, collector drives, compressors, silencers, etc.

- B. All push buttons, starters, switches, etc. when remote from the equipment controlled and/or power packs shall have engraved equipment tags fixed to or adjacent to the remote switch, push button, starter, etc.

END OF SECTION

SECTION 40 41 00

PROCESS PIPING AND EQUIPMENT HEAT TRACE AND INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes requirements for heat trace and insulation of pipe and equipment
- B. Schedule:
 - 1. Heat trace is required for all exposed water, wastewater, sample and chemical lines smaller than 8" and where specifically noted in the specifications or indicated on the drawings.
 - 2. In general, small piping is to be installed inside heated spaces, buried below the frost line, or in underground vaults. Where piping must be exposed, pipe insulation and heat tracing is required.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 09 91 00 - Painting
 - 3. Section 40 05 00 - Common Work Results for Process Interconnections

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
 - 2. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation
 - 3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - 4. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation
- B. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE 515-2017 - Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Industrial Applications

C. National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code (NEC)

1.04 SUBMITTALS

A. Submit shop drawings of pipe and fittings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.

B. Product Data

1. Include manufacturer's technical data, specifications, and installation instructions for heat trace systems, insulation, and accessories.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5-years experience in manufacturing heat trace systems and insulation for industrial applications.

B. Self-regulating heating cable shall be designed for a useful life of 20 years.

C. All cables shall be capable of passing a 2.2 kV dielectric test for one minute after undergoing a 10 ft-lb. impact.

D. Heat trace and insulation shall have a warranty period against defects for a period of 10 years

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original packaging with labels intact.

B. Store in a dry, protected environment to prevent damage.

C. Handle to avoid damage to insulation and heat trace components

1.07 WARRANTY

A. Manufacturer's Warranty: 10 years from date of Substantial Completion against defects in materials and workmanship.

B. Coverage: Includes repair or replacement of defective components, including labor for removal and reinstallation, at no cost to the Owner.

PART 2 - PRODUCTS

2.01 PIPE INSULATION

A. Material: Rigid, molded, preformed fiberglass per ASTM C547 or elastomeric foam per ASTM C534, suitable for exposed or buried service.

1. Thermal Conductivity: 0.2 Btu-in/(hr-ft²-°F) or better at 75°F (24°C)

2. Resistant to ultraviolet radiation, moisture, and physical abuse
3. Molded covers shall be used at all fittings, valves and appurtenances.

B. Manufacturer: Johns Manville Micro-Lok or equal.

2.02 ALUMINUM JACKETING

- A. Material: Aluminum alloy per ASTM B209, alloy 3003, 3105, or 5005, with smooth or corrugated finish
1. Thickness: Minimum 0.016 inches (0.4 mm) for piping, 0.024 inches (0.6 mm) for equipment.
 2. Moisture Barrier: Factory-applied polyethylene or polysurlyn backing.
 3. Resistant to corrosion, ultraviolet radiation, and mechanical damage.
 4. Preformed aluminum covers matching insulation contours at fittings and valves.
 5. Fasteners: Stainless steel bands or screws, spaced per manufacturer's recommendations.

2.03 HEAT TRACING SYSTEM

- A. Type: Heat trace systems shall be self regulating heating cable that shall vary its power output relative to the temperature of the surface of the pipe or vessel.
- B. Voltage: 120 or 220 VAC, as indicated on the drawings
- C. Heating Cable:
1. Heating cable shall consist of two 16 AWG or larger nickel-plated copper bus wires, embedded in a self-regulating polymeric core that controls power output so that the cable can be used directly on plastic or metallic pipes.
 2. The heating cable shall have a tinned copper braid with a resistance less than 8 mΩ/ft as determined by metallic covering conductivity test (IEEE 515- 2017 test 4.1.13). The braid may be protected from chemical attack and mechanical abuse by an optional polyolefin or fluoropolymer outer jacket.
 3. Manufacturer: nVent RAYCHEM SRL or XL-Trace, Chromalox Type SRL, or equal.
- D. Temperature Controller: Remote-mount, Model 3282 or AMC-1B, with remote thermocouple
- E. Connection Kits: Manufacturer-provided for power, splice, and end terminations
- F. Power Distribution and Continuity Monitoring
1. Enclosure: NEMA 4X for outdoor or wet environments
 2. Circuit breakers: Mini breakers with 30 mA ground-fault protection per NFPA 70
 3. Main contactor: Required for systems with multiple circuits

4. Monitoring: Panels shall include alarms for individual heat-tracing circuit failures.
 5. Manufacturer: Same as heat trace system manufacturer.
- G. Temperature Settings: (During and ambient temperature of 0° F)
1. Caustic Soda or Sodium Aluminate: 75° F
 2. Other Chemicals: 45° F
 3. Water: 45° F

PART 3 - EXECUTION

3.01 DESIGN

- A. The manufacturer shall be given a line list from which to design and estimate a complete heat-tracing system. The design shall also include area layout and orthographic drawings. The vendor shall provide a detailed design utilizing standard heat-tracing design software. Design to include:
1. Circuit identification number
 2. Maintain temperature.
 3. Line size and insulation
 4. Heat loss for pipe, valves, and supports
 5. Amount and type of heating cable required
 6. Spiral requirements

3.02 INSTALLATION

- A. General
1. Install per manufacturer's engineering details, isometric drawings, line lists, and instructions.
- B. Heat Trace
1. Secure cable to pipe or equipment per manufacturer's recommendations.
 2. Ensure proper looping at fittings, flanges, and valves.
 3. Test continuity and insulation resistance before energizing.
- C. Insulation:
1. Apply insulation over heat trace, ensuring complete coverage.

2. Use molded covers for fittings, valves, and appurtenances.
3. Seal joints to prevent moisture ingress.

D. Aluminum Jacketing:

1. Install over insulation, ensuring tight, weatherproof fit.
2. Use preformed covers for fittings and valves.
3. Secure with stainless steel bands or screws, spaced per manufacturer's recommendations.
4. Overlap seams by minimum 2 inches (50 mm); seal with butyl rubber tape or equal. E. Documentation: Record circuit numbers, model numbers, actual footage installed, and aluminum jacketing details on As-Built Drawings.

- E. Heat Trace Controls: The system controls shall be located in the chemical feed building for chemical applications. For water piping applications, the control location shall be approved by the Engineer.

3.03 FIELD QUALITY CONTROL

A. . Testing:

1. Verify continuity and insulation resistance of heat trace circuits.
2. Test system operation at design temperatures.
3. Confirm ground-fault protection functionality. B. Inspection: Verify insulation thickness, coverage, aluminum jacketing installation, and sealing

- B. Installation Records: Installer shall keep records of all heating cable installed on site per job requirements – at a minimum circuit number corresponding with heat trace isometric drawing with model number, actual footage installed shall be documented on As Built Drawings.

3.04 CLEANING AND PROTECTION

- A. Remove debris and clean surfaces before insulation and jacketing application.
- B. Protect installed systems from damage during construction.

3.05 DEMONSTRATION

- A. Train Owner's personnel on operation, maintenance, and troubleshooting of heat trace system.

END OF SECTION

SECTION 40 71 00
FLOW MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements for flow measurement devices used in process systems including:
 - 1. Clamp-On Ultrasonic Flow Meters
 - 2. Venturi Flow Meters
 - 3. Electromagnetic Flow Meters (Mag Meters)

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 40 05 00 - Common Work Results for Process Interconnections

1.03 REFERENCES

- A. American Water Works Association (AWWA) Standards
- B. NSF/ANSI Standard 61 and 372 - Drinking Water System Components
- C. National Institute of Standards and Technology (NIST) Calibration Standards

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
- B. Product Data:
 - 1. Cutsheets and catalog information for the following: manufacturer's literature, illustrations, specifications, and engineering data to include materials of construction, dimensions and weights, pressure ratings, flow measurement ranges, accuracy, characteristics and other details.
- C. Shop Drawings:
 - 1. The shop drawings shall include installation drawings, mounting details and wiring diagrams for controls communications and SCADA monitoring.

- D. Quality Assurance/Control Submittals:
 - 1. Material compliance certificates
 - 2. Factory test reports
 - E. Operation and Maintenance Manuals: Submit in accordance with Section 01 78 23.
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications:
 - 1. The manufacturer must have at least 20 years experience in providing flow metering equipment in water and wastewater.
 - 2. Manufacturers must provide the Engineer with written certification confirming that all flow tubes, inserts and/or appurtenances in contact with process water meet the applicable requirements of the specified AWWA standards.
 - B. Testing Requirements:
 - 1. Flow meters must be calibrated and tested in the field during or after installation.
- 1.06 WARRANTY
- A. Provide a warranty against defective materials and workmanship in accordance with the specifications.
- 1.07 REGULATORY REQUIREMENTS
- A. All products or materials that will come into contact with drinking water must be NSF/ANSI standard 61 and 372 certified.

PART 2 - PRODUCTS

2.01 HYBRID FLOW METER

- A. Manufacturers:
 - 1. Flexim
 - 2. Approved equal
 - a. Approval for an equivalent flowmeter will be given if the proposed flowmeter meets these Specifications and upon an actual successful demonstration of the equipment on the intended or similar application.
 - b. The meter must be a clamp-on design with no liquid contact that mounts externally on the pipe. Two sets of submersible (IP68) clamp-on flow transducers will be provided, complete with mounting rail and brackets. The transducers will measure flow in the pipeline. The transducers will share a flow analyzer for flow indication and transmittal to the plant SCADA network. One set of submersible (IP68) clamp-on flow transducers will be provided, complete with mounting rail and brackets, for

use at the return sludge pump station. The transducers will connect to the flow analyzer for flow indication and transmittal to the plant SCADA network.

B. Type: Clamp-on design with no liquid contact that mounts externally to the pipe

C. Scope:

1. The meter must utilize the transit-time flow measurement technique and employ the use of two microprocessors and have the ability to monitor two independent flow channels simultaneously (second channel optional).
2. The metering electronics must have the ability to operate HIGH TEMPERATURE flow sensors capable of monitoring liquids at temperatures in excess of 750°F.
3. The meter must also have the ability to employ an alternate Doppler measurement technique for liquids with high air or solid content.
4. The meter must have a multi-point (7 points minimum) wet flow calibration certificate accredited from an international standards agency with an accuracy of better than 1%.
5. The meter must have a transducer encased in stainless steel with an integral armored stainless steel jacketed triax cable. The use of coax cable and BNC cable connections will not be acceptable.
6. The transducers are to be mounted in a fully sealed (water tight) stainless steel mounting track and have the ability to be coupled using permanent coupling pads. Grease is NOT acceptable.
7. All transducer markings and identification must be laser scribed and solvent resistant. The use of adhesive labels for transducer identification is NOT acceptable.
8. All transducers supplied must have a multi-point (7 points minimum) wet flow calibration certificate accredited from an international standards agency with an accuracy of better than 1%. All calibration and transducer data must reside in a non-volatile memory chip located in the transducer junction box or flow meter.
9. The meter must have the ability to automatically recognize the transducers when connected. Programming of the transducer type into the meter will not be acceptable.
10. The meter must be of a type that requires NO zero calibration. The zero calibration must be factory pre-set automatic without the need for zero check/calibration after installation. There must not be any zero drift mechanisms (i.e. temperature change related drift) as the meters can NOT be installed with any low-flow cutoff or "deadband".
11. The meter must also provide automatic Reynolds number, liquid sonic velocity compensation, and have built in liquid tables for automatic sound velocity, viscosity and density settings.
12. The flowmeter electronics shall be housed in a NEMA 4X enclosure and have the ability to indicate flow rate, flow velocity, mass flow, total flow, signal strength, signal quality, liquid sonic velocity, Reynolds regime (laminar/turbulent/transition).

13. The meter must have the ability to have dynamic (automatic) compensation for changes in viscosity and density.
14. The meter must be able to have inputs for Pt100 4 wire temperature RTD, 4-20ma input for temperature, 4-20ma for pressure, 4-20ma for density.
15. The meter shall be capable of outputting multiple 4-20ma, Voltage 0-1v or 0-10v, high precision frequency 0-1kHz or 0-10kHz galvanically isolated, RS-232, RS-484, binary output pulse or alarm for relay total and meter status.
16. The meter shall have the ability to status alarm for conditions of fault, flow direction, sound velocity limit, flow velocity limit.
17. The meter shall have the ability to set the 4-20ma to a settable status condition (i.e. 2ma for an alarm condition).
18. The meter shall have RS-232 output and internal memory with a minimum storage of 100K data points

D. Service: Provide a manufacturer's representative for initial start-up, testing and training for a minimum of one 8-hour day.

2.02 FLOW RATE TRANSMITTERS (VENTURI FLOW METER)

A. Manufacturers:

1. PFS (Primary Flow Signal)
2. BIF
3. Or approved equal

B. Scope:

1. Each flow meter shall consist of a venturi type differential producing flow element and a differential pressure flow transmitter. Sizes and locations shall be as shown on the Drawings.
 - a. Flow Elements: Primary flow elements shall be venturi type and shall produce a differential pressure sensed at the inlet and at the throat.
 - 1) The body shall be cast iron ASTM A126, Grade B. The throat bushing material shall be 304 stainless steel. End connections shall be 125 ANSI flanges. Each tube shall be hydrostatically tested at 150psi .
 - 2) Two diametrically opposed main taps and two diametrically opposed throat taps shall be provided for differential pressure measurement connections. Centerline of the main taps and throat taps shall be in a horizontal plane. Holes shall be drilled at right angles to the axis and be burr free. Corner taps are not acceptable. A drain and a vent connection shall be provided at right angles to the main pressure taps when the tube is installed for steam or gas service.
 - 3) All surfaces, except the throat and the flange faces, shall be coated with United States EPA approved Series 20 Pota-Pox Epoxy-Polyamide Potable System or other coating approved by the US EPA for potable water applications. The

discharge coefficient shall not be less than 0.965 with uncalibrated accuracy of +/-0.5% over a range of 10:1 with a minimum Reynolds number which varies with tube size.

- 4) Field Wiring: Contractor shall coordinate all field wiring between filter console, instrumentation and control valves as shown on the drawings or as described herein.

2.03 ELECTRONIC FLOW TUBE METER (MAG METER)

A. Manufacturers:

1. Endres+Hauser (Promag)
2. Rosemount
3. Or approved equal

B. Scope:

1. Provide electromagnetic flow meters suitable for fixed-site measurement of bi-directional flow measurement in full pipes, consisting of a spool piece flow tube and flow transmitter for totalizing and SCADA integration, as shown on Drawings
2. The flow tubes shall use a spool piece configuration with field-interchangeable sensors containing coils and electrodes.
3. Each flow meter shall consist of a venturi type differential producing flow element and a differential pressure flow transmitter.
4. Sizes and locations shall be as shown on the Drawings.

C. Spool Piece Flow Tube and Sensors:

1. The nominal diameter of the flow tubes shall be as noted or if not noted, to match the nominal diameter of the pipe to which it is attached.
2. The spool piece flow tube shall be made of carbon steel and shall be a fusion bonded polyethylene finish inside and outside. O ring seals shall be made of Viton, and standpipe gaskets shall be made of nitrile rubber.
 - a. The flow tube shall not require an insulating liner. The flow tube liner shall be polyethylene that conforms to National Sanitation Foundation Standard 61 for use with potable water. Accuracy shall be not be affected by cuts or scratches in the flow tube liner.
 - b. The flow tube shall be supplied with raised face carbon steel flanges to ANSI 150rf Table D.
3. Each flow sensor shall contain a coil, a pair of sensing electrodes and an integral grounding electrode. The sensors shall use solid state design with the coils, electrodes and other sensor components encapsulated in polyurethane that conforms to National Sanitation Foundation Standard 61 for use with potable water.

- a. The electrodes shall be made of Type 316 stainless steel.
 - b. The flow tube shall use unipolar pulsed AC electromagnetic excitation with typical magnetizing current of not less than 1A base to peak and frequency of not less than $\frac{2}{3}$ of power supply frequency (40 Hz for a 60 Hz power supply frequency) to ensure a high signal-to-media noise ration.
4. The minimum media conductivity shall be 0.5 microS/cm.
5. The maximum media temperature shall be 175 ° F (80 ° C).
6. The flow meter shall include multiple sensors to measure mean velocity in full pipes.
 - a. The mean velocity measurement range shall be from 0.1' per second to 40' per second.
 - b. The minimum detectable mean velocity shall be 0.02' per second.
 - c. The mean velocity shall be measured with a maximum error of $\pm 0.005'$ per second over a range of less than 1' per second and $\pm 0.5\%$ of flow rate over a range of 1' to 40' per second. A mean velocity of 0.1' per second shall be measured with a maximum error of $\pm 5\%$ of reading. Accuracy shall be traceable to the US National Institute of Standards and Technology (NIST) and shall be guaranteed on-site for applications such as drinking water, raw sewage and similar media, even with a permanent coating of raw sewage or similar on the electrodes provided that specification parameters and installation recommendations are met. A NIST traceable calibration certificate shall be provided with each flow meter.
 - d. The temperature coefficient shall be less than 0.05% per 10° F.
 - e. A non-full pipe condition shall be indicated by a user-supplied signal into one of the contact inputs on the flow transmitter.
 - f. Maximum pressure shall be 150 psi (10 bar).
7. The wiring from the flow transmitter to the sensors shall be one 8-conductor cable, 18 gauge (0.75 mm²), twisted and shielded. The wiring from the flow transmitter to the sensors shall be as shown on the Drawings.
8. The flow tube and sensors shall exceed the NEMA 6P (IP68) submersibility standard and shall be submersible to 33'.
9. The flow tube shall have a 10-year warranty and the sensors a 5-year warranty.

D. Flow Transmitter:

1. The flow transmitter shall be microprocessor-based, and shall contain a keypad and a 2 line, 32 character, backlit alphanumeric liquid crystal display (LCD) with characters 0.3" high and 0.2" wide. The LCD shall visually prompt the user through the programming sequence, and the flow transmitter shall include a built-in help system. The LCD shall display flow rate and/or total flow in user-selectable units of measure. The flow transmitter shall be capable of displaying forward, reverse, net and grand total flows, and the totalizers shall be resettable or non-resettable.

2. The flow transmitter shall include two (2) isolated contact inputs, activated by contact closure or transistor, programmable to acknowledge alarms, reset totalizers, select the current flow rate range in forward flow/multi range mode, or indicate non-full pipe condition.
3. The flow transmitter shall include an isolated, internally powered 4 to 20 mA output into a maximum of 500 ohms. The 4 to 20 mA output shall be programmable to operate in either forward flow rate, forward flow rate/multi range, bidirectional flow rate or bidirectional flow rate/split range mode.
 - a. In forward flow rate mode, 4 mA shall represent zero flow rate, and 20 mA shall represent the programmable maximum forward flow rate.
 - b. In bidirectional flow rate mode, independent maximum forward and reverse flow rates shall be programmable with flow direction indicated by a relay output.
 - c. In bidirectional flow rate/split range mode, 4 mA shall represent the programmable minimum reverse flow rate, and 20 mA shall represent the programmable maximum forward flow rate.
4. The flow transmitter shall include a two (2) wire solid state pulse output, internally powered, rated 25 volts DC, 80 mA. The pulse output shall be programmable to operate in either scaled or frequency mode.
 - a. Scaled mode shall be used for totalizing, with a programmable maximum frequency of 5, 10 or 100 Hz and a corresponding pulse width of 100, 50 or 5 ms, respectively.
 - b. Frequency mode shall be used for rate indication, with a square wave output programmable from 0 to 1,000 Hz to 0 to 10,000 Hz.
5. The flow transmitter shall include two isolated, normally open relay contacts, activated based on reverse flow, high or low flow rate, total flow, or diagnostic errors, rated 60 volts DC, 30 volts AC RMS, 3 A resistive.
6. The flow transmitter shall be Factory Mutual (FM) Approved for use in ordinary locations.
7. The flow transmitter shall operate on 120 VAC, 50/60 Hz, line power. Typical power consumption shall be 10 W, including the sensors.
8. The flow transmitter shall be housed in a rugged, watertight, dust-tight, corrosion resistant (NEMA 4X and IP65) cast aluminum, epoxy painted enclosure suitable for conduit connections. The enclosure shall include a polycarbonate window for viewing the LCD without opening the enclosure.
9. The flow transmitter shall have a 2-year warranty.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install flow measurement devices in accordance with manufacturer's instructions and Drawings.
- B. Ensure proper mounting, alignment, and connection to process piping and SCADA systems.

C. Coordinate field wiring as specified or shown on Drawings.

3.02 STARTUP AND CALIBRATION

A. Perform field calibration and testing as required by manufacturer

END OF SECTION

SECTION 40 72 00

LEVEL MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements for flow measurement devices used in process systems including:
 - 1. Liquid Level Transmitters and Controllers
 - 2. Submersible Level Transmitters
 - 3. Pressure and Rate of Flow Transmitters
 - 4. Float Switches

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 40 05 00 - Common Work Results for Process Interconnections

1.03 REFERENCES

- A. American Water Works Association (AWWA) Standards
- B. NSF/ANSI Standard 61 and 372 - Drinking Water System Components
- C. National Institute of Standards and Technology (NIST) Calibration Standards
- D. UL Standards for Water and Sewage
- E. CSA Certification Standards

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
- B. Product Data:
 - 1. Cutsheets and catalog information for the following: manufacturer's literature, illustrations, specifications, and engineering data to include materials of construction, dimensions and weights, pressure ratings, flow measurement ranges, accuracy, characteristics and other details.

- C. Shop Drawings:
 - 1. The shop drawings shall include installation drawings, operator mounting details and wiring diagrams for electric operators.
 - D. Quality Assurance/Control Submittals:
 - 1. Material compliance certificates
 - 2. Factory test reports
 - E. Operation and Maintenance Manuals: Submit in accordance with Section 01 78 23.
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications:
 - 1. The manufacturer must have at least 30 years experience in providing metering and sensing equipment in water and/or wastewater.
 - 2. Manufacturers must provide the Engineer with written certification confirming that all flow tubes, inserts and/or appurtenances in contact with process water meet the applicable requirements of the specified AWWA standards.
 - B. Testing Requirements:
 - 1. Level sensors and controllers must be calibrated and tested in the field during or after installation.
- 1.06 WARRANTY
- A. Provide a warranty against defective materials and workmanship in accordance with the specifications.
- 1.07 REGULATORY REQUIREMENTS
- A. All products or materials that will come into contact with drinking water must be NSF/ANSI standard 61 and 372 certified.

PART 2 - PRODUCTS

2.01 LIQUID LEVEL TRANSMITTERS AND CONTROLLERS FOR CHEMICAL TANKS

- A. Manufacturers:
 - a. Rosemount Series 1000 Non-Contacting Radar, Model 3490 Universal Controller
 - b. Or approved equal
- B. Operating Principle: Frequency Modulated, Continuous Wave. Nominal frequency range- 77-81 GHZ
- C. Transmitter

1. Measuring Range: 10 m (33 feet)
2. Accuracy: 2 mm (0.08")
3. Repeatability: 1 mm (0.04")
4. Process pressure range: full vacuum to 8 Bar (116 psig)
5. Process temperature range: -40 to 150 Deg C (-40 F to 302 Deg F)
6. Transmitter Housing:
 - a. Factory-sealed housing to IP66/68 and NEMA 4X
 - b. Integral M12 electrical connection
 - c. Electromagnetic compatibility to EMC Directive
 - d. NAMUR recommendations NE21 (only 4-20 mA output)
 - e. Capable of working at 100% Humidity
7. Antenna: Integral to the device
8. Signal Processing: Fast sweep Frequency Modulated Continuous Wave (FMCW) Radar Technology
9. Power: 18-30 VDC
10. Outputs
 - a. Primary Output: 4-20mA, configurable for Level, Volume, Flow
 - b. Other Outputs: IO-Link, Discrete (configurable PnP or NPN)
11. Device Configuration Options:
 - a. IO-Link Configuration Tool available through manufacturer
 - b. FDT® frame applications, e.g. PACTware
12. Ambient Operating Temperature Range: -40 to 176 degrees F
13. Transmitter Mount (typical): NPT connection, ANSI style flanges or Bracket Mount
14. Telecommunication compliance
 - a. Outdoor installations are compliant with Telecom requirements when the antenna is fitted with an extension (supplied with the bracket mount)
 - b. No restrictions when mounting indoors

D. Controller

1. Controller Housing Material: Polybutylene Terephthalate/Polycarbonate

2. Supply Power: 100-240 VAC
3. Sensor Power Output: 12 to 30 VDC
4. Sensor communication to Controller: HART, 4-20mA
5. Outputs
 - a. Primary: 4-20mA configurable for Level, Volume, or Flow
 - b. Additional Outputs:
 - 1) Up to Six SPDT relays rated 8 amps
 - 2) Modbus TCP/IP
6. System Configuration Options Selected:
 - a. Integral Keypad
 - b. AMS Device Manager Configuration Software
7. Controller Operating Temperature: -40 to 140 degrees F

E. Accessories:

1. Wall and Pipe Mounting Kit
2. Weather Protection Cover

F. Service: Provide a manufacturer's representative for initial start-up, testing and training for a minimum of one 8-hour day.

G. Spare Parts: One spare control unit.

2.02 SUBMERISIBLE LEVEL TRANSMITTERS AND CONTROLLERS FOR CLEARWELLS

A. Manufacturers:

1. Siemens SITRANS LH100 7MF1572-A2 pressure transducer with EPDM O-ring and PE-LD Cable
2. Or approved equal

B. Transmitter

1. Measuring Range: 10 m (33 feet)
2. Accuracy: 3% (1.19")
3. Process temperature range: 14 to 176 Deg F
4. Transmitter Housing:
 - a. Factory-sealed housing to IP68

- b. Integral electrical connection
 - 5. Primary Output: 4-20mA, configurable for Level
 - 6. Ambient Operating Temperature Range: -40 to 176 degrees F
 - 7. Transmitter Mount (typical): Polycarbonate or FRP By Manufacturer
 - C. Spare Parts: One spare transducer with cable.
- 2.03 PRESSURE AND RATE OF FLOW TRANSMITTERS
- A. Manufacturers:
 - 1. Rosemount 3051
 - 2. Smart DP
 - 3. Or approved equal
 - B. Rate of flow transmitters shall be 2-wire type and shall generate a standard 4-20 mADC output signal. Each transmitter shall be supplied complete with three-valve manifold.
 - C. The transmitter shall be of compact design with external span and zero adjustments.
 - D. Accuracy: $\pm 0.25\%$ of calibrated span for a range of 20% to 100% of flow (4% to 100% of differential pressure).
- 2.04 FLOAT SWITCH
- A. Type: Tilt-sensitive, wide angle float switch
 - B. Enclosure: Sealed, non-corrosive PVC
 - C. Approvals: UL listed for water and sewage and CSA certified.
 - D. Features: The float switch shall also be fitted with a piggy-back plug that allows the system to which it is a part to be operated manually without removal from the tank or sump.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Follow manufacturer's instructions for the mounting and installation considerations
- B. Mount level transmitter to ensure clear path to the material surface.
- C. Provide proper grounding to the transmitter housing.
- D. Coordinate field wiring with instrumentation and SCADA systems as shown on Drawings

3.02 STARTUP AND CALIBRATION

- A. Manufacturer's Representative shall provide programming, start-up and training services

- B. Perform field calibration and testing as required by manufacturer

END OF SECTION

SECTION SECTION 40 73 26

GAGE PRESSURE TRANSMITTER

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes requirements for furnishing, installing, testing, and commissioning gage pressure transmitters (PT) for process systems

- B. SYSTEM DESCRIPTION

- 1. The Contractor shall furnish all labor, equipment and materials required to install, test and place into satisfactory operation, the gage pressure transmitters listed below:

- a. PRESSURE TRANSMITTER - PT

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

- B. Related Sections:

- 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 78 23 - Operation and Maintenance Data
 - 3. Section 40 05 00 - Common Work Results for Process Interconnections

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's literature, including materials of construction, dimensions and weights, pressure and temperature ratings, measurement ranges and accuracies, and performance characteristics.
- C. Quality Assurance/Control Submittals: Material compliance certificates, factory test reports, and calibration certificates
- D. Operation and Maintenance Submittals: Submit in accordance with Section 01 78 23

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 years of experience in providing pressure measurement equipment for water and wastewater applications
- B. Provide written certification that components in contact with process liquid comply with NSF/ANSI Standards 61 and 372, where applicable.
- C. Testing Requirements: Calibrate and test transmitters in the field during or after installation.

1.05 SPARE PARTS

- A. One complete set of spare parts as recommended by manufacturer for each installation shall be furnished.

1.06 WARRANTY

- A. Provide a 1-year warranty against defective materials and workmanship, commencing upon equipment acceptance by the Owner and Engineer.
- B. Warranty shall cover all equipment, components, and systems, including replacement or repair of defective components at no cost to the Owner
- C. Where deemed necessary, the manufacturer will be responsible for the labor of removal and reinstalling the defective or faulty components without cost to the Owner.

PART 2 - PRODUCTS

2.01 GAGE PRESSURE TRANSMITTER

- A. Scope: A gage transmitter, complete with two valve manifold, shall be supplied to monitor in-line pressure.
- B. Manufacturers:
 - 1. Rosemount Model 3051S Ultra gage pressure transmitter
 - 2. Approved equal
- C. Specifications:
 - 1. Accuracy: Up to 0.025% of Span
 - 2. Stability: Up to +/- 0.15% of Upper Range Limit
 - 3. Rangedown: Up to 200:1
 - 4. Connection Type: In-Line
 - 5. Measurement Type: Gage
 - 6. Pressure Range: -14.7 to 150 PSI
 - 7. Isolating Diaphragm: 316L SST
 - 8. Process Connection: Assemble to Rosemount 306 Integral Manifold
 - 9. Transmitter Output: 4-20 mA with digital signal based on HART protocol
 - 10. Housing Style: PlantWeb Housing, Aluminum, 1/ 2" – 14 NPT Conduit entry
 - 11. Display Type: PlantWeb LCD Display

12. Mounting Bracket: All SST, 2-in. pipe and panel
 13. Stainless Steel Tag with Loop Number and Calibration (0 to 150 PSI)
 14. Provide Rosemount Model appropriate for location, operation, measurement and use.
- D. Transmitter: Equipped with a 316 SS 2-valve threaded instrument manifold conforming to the following specifications:
1. Manifold Style: Threaded
 2. Manifold Type: 2-Way
 3. Body: 316 SST/316L SST
 4. Bonnet: 316 SST
 5. Stem and tip/ball: 316 SST
 6. Process Connection Style: 1/2 – 14 ANPT Female for Inline Transmitter
 7. Packing Material: PTFE
 8. Valve Seat: Integral
 9. Provide Rosemount Model #0306RT22BA11

PART 3 - PART 3 EXECUTION

3.01 INSTALLATION:

- A. Installation procedures shall be per the manufacturer's recommendations.
- B. The installation locations are as shown on the contract drawings.

3.02 START-UP SERVICE

- A. Provide manufacturer's Field Service Technician (certified, factory trained) for a minimum of one 8-hour days on site. Field Service Technician shall calibrate instruments, check all installed equipment, perform initial start-up, make all tests, adjustments and related items as required to ensure that filter controls are performing and operating as specified and required, and train operators in daily operational procedures, O & M, trouble shooting, and computer operations.
- B. Field Service Technician will verify installation is in accordance with Drawings, Specifications and as instructed by manufacturer. The technician will schedule site visits at scheduled points of construction completion, coordinated with Contractor, to ensure proper installation of equipment, structures and facilities. Technician will coordinate with other manufacturers Field Service Technicians as required.
- C. Field Service Technician will instruct Owner's personnel in operational, maintenance and troubleshooting procedures.

3.03 CERTIFICATION OF INSTALLATION

- A. Upon completion of the installation, the manufacturer shall furnish a certificate of compliance detailing that the instruments and materials have been installed and calibrated in accordance with the manufacturer's instructions.

END OF SECTION

SECTION SECTION 40 75 16

STREAMING CURRENT AND CHARGE ANALYZERS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes requirements for streaming current indicators (SCI) and charge analyzers for water treatment processes, including:
 - 1. Streaming Current Indicators (SCI) for real-time measurement of net electrokinetic charge in treated water after coagulant addition.
 - 2. Charge Analyzers for measuring colloidal and ionic charge via Zeta Potential in raw water samples.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.
- B. Related Sections:
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 46 05 00 - Common Work Results for Water Equipment

1.03 DEFINITIONS

- A. Streaming Current Indicator (SCI): An online, continuous sampling instrument designed to measure the net electrokinetic charge (ionic and colloidal) of particles in treated water immediately after coagulant addition. It provides real-time feedback for optimizing coagulant dosage in water treatment processes, such as coagulation, flocculation, and clarification. The SCI must be suitable for surface water treatment plants handling fluctuating raw water conditions (e.g., turbidity, color, pH).
- B. The Charge Analyzer: An instrument designed to measure the colloidal and ionic charge of a raw water sample using Zeta Potential, a measurement of electrical potential, measured in millivolts. It serves as a rapid alternative to jar testing. The Charge Analyzer is used in water treatment plants to optimize and verify online coagulation control systems during operation.

PART 2 - PRODUCTS

2.01 STREAMING CURRENT INDICATOR (SCI)

- A. Manufacturers: Chemtrac DuraTrac 4 or approved equal
- B. Measurement Principle:

1. Measures streaming current generated by charged particles and ions moving through a sensor with a reciprocating piston.
2. Electrodes detect alternating current proportional to net charge density, indicating degree of charge neutralization (e.g., 0.0 SCV for complete neutralization)

C. Design Requirements

1. Sensor Type: Reciprocating piston in a closed-end cylinder (e.g., Micrometrix XL technology with renewable probe and replaceable Teflon sleeve).
2. Materials
 - a. Sensor Block: AISI 316L PVC
 - b. Piston and Sleeve: PTFE (Teflon) or high-density polyethylene (HDPE)
 - c. Electrodes: Platinum or stainless steel
 - d. Sample Cell: Transparent acrylic
 - e. Flow Path: 1/4–1/2 in. NPT inlet/outlet
3. Measurement Range: Streaming Current Value (SCV) -200 to +200
4. Accuracy: $\pm 5\%$ of SCV reading
5. Setpoint: Adjustable, typically near 0.0 SCV with slight offsets based on water quality
6. Response Time: <10 seconds to detect changes in water quality or coagulant dosage
7. Flow Rate: 5 GPM, adjustable
8. Operating Conditions
 - a. Temperature: 32°F to 122°F (0°C to 50°C)
 - b. Pressure: Up to 100 psi
9. Raw Water Characteristics
 - a. Turbidity: 5–5000 NTU
 - b. Color: 10–300 PtCo
 - c. pH: 4-10

D. System Features:

1. Display: 4–7 in. color touchscreen with graphical trending and tab-style menus
2. Enclosure: NEMA 4X or IP65 with sunshade, mounted on aluminum Unistrut or equivalent
3. Control: Native gain-based or PID control for paced samples
4. Inputs: Flow input and minimum two additional analog signals for multi-sensor control

5. Outputs
 - a. 4–20 mA analog output for PLC, SCADA, or dosing pump integration
 - b. Ethernet
 - c. 2–4 configurable high/low alarm relays
6. Data logging for 30–90 days of SCV and water quality trends
7. Alarm Functions
 - a. High/low SCV alarms for treatment upsets
 - b. SCADA integration for continuous monitoring

2.02 CHARGE ANALYZER

- A. Manufacturers: Chemtrac CA or approved equal
- B. Measurement Principle: Measures colloidal and ionic charge via Zeta Potential (millivolts) for rapid coagulant dosage optimization and verification
- C. Design Requirements
 1. Raw Water Characteristics
 - a. Turbidity: 5–5000 NTU
 - b. Color: 10–300 PtCo
 - c. pH: 4–10
 2. Accuracy: $\pm 5\%$ of Zeta Potential reading
 3. Response Time: <10 seconds
 4. Operating Conditions
 - a. Temperature: 32°F to 122°F (0°C to 50°C)
 - b. Pressure: Up to 100 psi
- D. System Features:
 1. Display: 4–7 in. color touchscreen with graphical trending and tab-style menus
 2. Enclosure: NEMA 4X or IP65 with sunshade, mounted on aluminum Unistrut or equivalent
 3. Outputs
 - a. 4–20 mA analog output for PLC, SCADA, or dosing pump integration
 - b. Ethernet

- c. 2–4 configurable high/low alarm relays
- 4. Data logging for 30–90 days of Zeta Potential and water quality trends

2.03 ACCESSORIES

- A. Sample conditioning kit, including filters and flow regulators
- B. Mounting hardware for wall or pole installation
- C. Sunshade for outdoor installations

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install streaming current and charge analyzers per manufacturer's instructions and Drawings.
- B. Ensure proper alignment, flow path, and connections to process piping and SCADA systems.
- C. Drain to wastewater piping or sewerage system with air gap.
- D. Coordinate electrical power supply with Division 26 Sections.

3.02 FIELD QUALITY CONTROL

- A. Perform field calibration and testing per manufacturer's instructions and Section 1.5.
- B. Verify system operation across the specified turbidity range (100–5000 NTU).
- C. Provide a certificate of compliance upon completion, verifying installation and calibration per manufacturer's instructions.

3.03 TRAINING

- A. Train Owner's personnel on operation, maintenance, and troubleshooting procedures during startup

END OF SECTION

SECTION 41 22 13

BRIDGE CRANES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes furnishing and installing bridge crane equipment and accessories.
- B. Each system shall be furnished and installed in locations indicated on the drawings, complete with all hoisting equipment, rail systems, and accessories necessary for a complete and properly operating installation.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the contract including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 01 78 23 – Operation and Maintenance Data
 - 3. Section 09 91 00 – Paints and Coatings
 - 4. Division 26 – Electrical

1.03 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B30.2 - Overhead and Gantry Cranes
 - 2. ASME B30.10 – Hooks
 - 3. ASME B30.11 – Underhung Single Girder Bridge Cranes
 - 4. ASME B30.16 – Overhead Hoists (underhung)
- B. Crane Manufacturers Association of America (CMAA)
 - 1. CMAA 74 - Specifications for Top Running and Under Running Bridge and Gantry Type Single Girder Electric Overhead Traveling Cranes
- C. Occupational Safety and Health Association (OSHA)
 - 1. OSHA 1910.179 - Overhead and Gantry Cranes

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the requirements of the Contract Documents and the requirements of Section 01 33 00.
 - B. Submit crane design including beam/girder loading information for structural engineering review
 - C. Product Data:
 - 1. Cutsheets and catalog information for the following: manufacturer's literature, illustrations, specifications, and engineering data to include materials of construction, dimensions and weights, accuracies, characteristics and other details.
 - D. Shop Drawings:
 - 1. The shop drawings shall include fabrication details, installation drawings, mounting details and wiring diagrams for electric trolley.
 - 2. Mounting details, bolts, clamps, straps, angles, braces, hangers and all mounting hardware for runway and bridge/trolley, including dimensioned drawings and structural details.
 - E. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23.
- 1.05 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Minimum 5 years' experience producing similar cranes; ISO 9001 certified.
 - B. Installer Qualifications: Certified by manufacturer; experienced in crane installation per CMAA guidelines.
 - C. Source Limitations: Single manufacturer for cranes and components.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Deliver components protected against weather and damage.
 - B. Store in manufacturer's original packaging.
- 1.07 WARRANTY
- A. Provide a warranty against defective materials and workmanship in accordance with the specifications.
- 1.08 PROJECT CONDITIONS/ SITE CONDITIONS
- A. Field verify all dimensions prior to shop drawing submittal and fabrication.
 - B. Installation is indoor, harsh environment, provide outdoor rated crane.

PART 2 - PRODUCTS

2.01 BRIDGE CRANE EQUIPMENT:

- A. The Contractor shall furnish bridge crane & appurtenances shown on the Drawings and specified herein including all hangers, brackets, clamps, anchors, anchor bolts and other necessary equipment required for a complete installation.
- B. Contractor shall provide runway beam per crane manufacturer's requirements.
- C. Bridge shall consist of one, precision rolled beam section. Section shall be rigidly braced, securely fastened, and shall maintain proper alignment.
- D. Drives shall be shock free and shall be demonstrated to provide movement of process load without sway.
- E. Although to be installed indoors, all equipment shall be suitable for outdoor service with stainless steel drums and wire rope. Festoons shall have C-track with 12/4 power cable and stainless steel brackets and trolleys. Bridge crane and hoist shall be manufactured by D.R. Cordell & Assoc., Inc. 95 W. Butler Ave., Chalfont, PA, or approved equal.

1. Equipment Details

a.	Lift Capacity	1 Ton
b.	Lift Height	20'
c.	Lift Speed	Variable
d.	Crane Span	Refer to Drawings
e.	Trolley Speed	Variable
f.	Bridge Speed	Variable
g.	Bot/Roof Bm Flg > Hook Dim. (max)	46"
h.	Control Operation	Radio
i.	Voltage (Crane)	460
j.	Voltage (Control)	120

- F. Trolley: Contractor shall provide a monorail type trolley of steel construction, compatible with aluminum runway beam and bridge girder, suitable for outdoor service, adjustable for a variety of monorails sizes. Trolley motion shall be shock-free and shall be demonstrated to move process loads without sway. Side plates shall act as bumpers to protect wheel flanges from damage. Trolley wheels shall be equipped with ball bearings. Carrier shall be welded and shall transmit imposed loads to the bridge girder without undue deflection.
- G. Hoist: A hoisting machine of proper capacity shall be mounted to the trolley, with motor specifically designed for hoisting duty. Hoist shall be provided with a electrical brake of sufficient size to promptly stop the motor rotation in either direction and hold the load. The drum diameter shall be at least 20 times the rope diameter. With the hook in its lowest position, there shall be at least two turns remaining on the drum.

- H. Rope: The hoisting rope shall be improved plow steel of suitable diameter to provide a safety factor of at least 5. Rope shall be easily detachable for replacement. The load block shall be equipped with a swivel type safety latch hook.
- I. Controller: Provide a pendant type pushbutton control station suspended on a bonded strain cable. Controller hanger shall be permanently mounted 4' AFF with cover. The Control Station shall provide full control of the motions of the bridge, trolley and hoist, including speed control. The station shall consist of buttons having the following buttons, at a minimum:
 - 1. Bridge Forward
 - 2. Bridge Reverse
 - 3. Trolley Forward
 - 4. Trolley Reverse
 - 5. Hoist Up
 - 6. Hoist Down
 - 7. Start
 - 8. Stop (Stop Button shall have a red mushroom head).

PART 3 - EXECUTION

3.01 INSTALLATION

- 1) Follow manufacturer's instructions for the mounting and installation considerations

3.02 TESTING

- A. Provide confirmation test that process loads do not experience shock loads, unsafe accelerations or swaying.
- B. Contractor shall provide certified load test in accordance with OSHA 1910.179

END OF SECTION

SECTION 43 23 13

CENTRIFUGAL SAMPLING PUMPS

PART 1 - GENERAL

Provide Centrifugal type water sample pumps as indicated, specified, or shown, mounted as required for a complete and proper installation.

1.01 SUMMARY

A. Section Includes

1. Self-priming, magnetic-drive centrifugal pumps for water sampling applications, including mounting bases, motors, and accessories.
2. Pumps designed for handling clean or slightly contaminated water.

1.02 RELATED DOCUMENT

A. Construction drawings and general provisions of the contract including the General and Supplementary Conditions.

B. Related Specifications

1. Section 01 33 00 – Submittal Procedures
2. Section 40 05 00 – Common Results for Process Piping Interconnections
3. Section 40 05 07 – Hangers and Supports for Process Piping

1.03 DESCRIPTION

A. Sample pumps shall be centrifugal, self-priming without mechanical seals and equipped with self-radiating bearing structure and non-contact dry run capability.

B. The key components of this system are as follows:

1. Centrifugal Sample Pumps
2. Fabricated HDPE or aluminum Shelf anchored as necessary.

1.04 QUALITY ASSURANCE

A. Centrifugal sampling pumps shall be IWAKI SMX series pumps or approved equal.

B. This specification is the basis for design of centrifugal sample pumps. All pumps,

C. Whether named as an acceptable supplier or submitted as an equal shall, at a minimum, meet the following critical design requirements.

1. Pump shall be capable of repeatable self-priming.
2. Self, dry-prime up to 13 feet in under 90 seconds.
3. The pump wet end can be removed from the motor as a complete assembly without dismantling, using an additional rear casing support.
4. Pumps shall meet CE, NSF 61 and applicable electrical standards.

1.05 SUBMITTALS

A. Submit the following:

1. Certified shop drawings.
2. Characteristic performance curve showing flow rate as a function of RPM and pressure.
3. Sampling Pump Arrangement & Installation drawings.
4. Operating, maintenance, programming, and wiring instructions

1.06 DELIVERY, STORAGE, & HANDLING

A. Shipping

1. Ship the sampling pump completely assembled and ready for installation. Ship tubing separately for field installation and process line connection by contractor.
2. Pack all additional spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Deliver spare parts at the same time as pertaining equipment. Deliver to Owner after completion of work.

B. Receiving

1. Contractor to inspect and inventory items upon delivery to site.
2. Contractor to store and safeguard equipment, material, instructions, and spare parts in accordance with manufacturer's written instructions.

1.07 SPARE PARTS

A. Provide one spare complete pump of each type provided.

1. Package spare pumps for storage and clearly identify packaging

PART 2 - PRODUCTS

2.01 CENTRIFUGAL SAMPLE PUMP PERFORMANCE REQUIREMENTS

- ##### A. Pumps shall be self-priming and shall have a minimum suction lift capability of 13-feet vertical water column.

- B. Pump shall not require the use of back pressure valves, suction foot valves, strainers, pulsation dampeners, or auto degassing valves

1. Sampling Pump Process Schedule

Sampling Pump	Pump Capacity	Chemical Line Size
1) Raw Water	1) 2.5 GPM @ 40 FT TDH	1) 0.75 inch
2) Dosed Water	2) 4.65 GPM @ 37 FT TDH	2) 0.75 inch
3) Settled Water	3) 2.8 GPM @ 60 FT TDH	3) 0.5 inch
4) Combined, Filtered	4) 2.4 GPM @ 62 FT TDH	4) 0.5 inch
5) Filtered, Dosed	5) 5.6 GPM @ 36.6 FT TDH	5) 0.75 inch

C. Enclosure

1. NEMA 4X constructed out of corrosion and impact resistant engineering plastic. Enclosure shall house the drive motor and all control circuitry in one integrated unit. Separate VFDs and motors are not acceptable.
2. CFRETFE Fluoroplastic front case, rear case, rear casing, volute spacer, and impeller

D. Drive

1. TEFC motor – minimum ½ HP
2. Rating: Continuous 24-hour operation, 45o C ambient.
3. Voltage: Drive shall be suitable for 120-240VAC, 60Hz,
4. Phase with an internal switch-mode power supply. Supply nine- foot length mains power cord with standard 115VAC three-prong plug.
5. Drive motor: brushless DC motor with integral gearbox compensation and protection.

PART 3 - PRODUCTS

3.01 INSTALLATION

- A. Contractor shall install items in accordance with manufacturer's printed instructions and as indicated and specified.
- B. Contractor to connect suction, discharge, vent and drain connections as required. Each pump shall be provided with a stainless steel check valve and ball valve on the discharge and ball valves on suction lines and fittings as indicated or required.
- C. All exposed sample piping shall be heat traced and insulated
- D. Furnish true union couplings at pump suction and discharge connections.

- E. Performance Test: After sampling pumps have been put into regular operation for 11 months, contractor shall ensure that each sampling pump is fully functional and that the Owner is in possession of one unused back-up pump for each sample type.

END OF SECTION

SECTION 43 24 13

VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.01 GENERAL

- A. TYPE OF PUMP AND PUMP COMPONENTS: This Specification is for Close-coupled open line shaft, vertical turbine pumps with above-ground flanged discharge and enclosed impellers. All parts of the pump exposed to water shall be of stainless steel, brass, heavy cast iron, or equivalent corrosion-proof material. C. Vertical turbine pumps shall be water lubricated type. Guaranteed performance curves and certified test curves shall be submitted by the manufacturer. Information from manufacturer shall include performance curve showing head capacity curves, speeds, efficiencies and brake horsepower at both design points and stating maximum BHP required by the pump at maximum allowable RPM.
- B. AWWA STANDARD: Unless otherwise specified herein, all applicable provisions of AWWA E-103 (Horizontal and Vertical Line Shaft Pumps), latest, are hereby made a part of these Specifications.
- C. TERMS AND DEFINITIONS:
 - 1. The term "Pumping Unit" or "Units" shall be defined as a pump complete with motor, head assembly, bowl assembly, column assembly and other materials and components as described herein.
 - 2. The term "Contractor" shall be defined as the general contractor or the organization entering into the contract with the Owner.
- D. ACCEPTED MANUFACTURER: The pumps shall be manufactured by Peerless, Floway, or approved equal as detailed in Part 2 of this specification. Refer to Par. 1.06 for Alternate Pump Manufacturer Requirements.

1.02 BASIC OPERATING REQUIREMENTS

- A. GENERAL
 - 1. Each pump will be used for pumping potable Cold Water and shall be NSF 61 and NSF 372 certified .
 - 2. The capacities, heads, efficiencies, and horsepower requirements specified herein are for completely assembled units.
 - 3. Each pumping unit shall meet the requirements and design points as specified in the Pump Schedule.

- B. PUMPING UNIT REQUIREMENT: Each pump and motor combination shall be matched to deliver at least the maximum flow rate at the maximum speed.

1.03 UNIT RESPONSIBILITY

A. GENERAL

1. The Pump Manufacturer shall be responsible for providing the pump, lineshaft, pump shaft, motor shaft (with bronze adjusting nut), column piping discharge head, and the motor as a complete unit to the Contractor for installation.
2. During the submittal process, the Pump Manufacturer shall provide a notarized certificate stating that all equipment and materials listed above will be provided by the Pump Manufacturer.
3. Pump Manufacturer or representative shall attend pump start-up and provide field services for assistance to the Contractor. Refer to Par. 3.04 of these specifications.

B. COMPATIBLE EQUIPMENT:

1. All combinations of manufactured equipment which are approved under this specification shall be entirely compatible and the Contractor and the listed manufacturer shall be responsible for the compatibility and successful operation of the various components of the units conforming to the specified requirements.
2. All necessary mounting, couplings and appurtenances shall be included with each unit. Anchor bolts shall be supplied by the contractor.
3. All materials employed in the pump equipment shall be suitable for the intended application and shall be high grade commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

1.04 REFERENCE CODES AND STANDARDS

- A. All equipment and materials shall meet the applicable provisions of the following reference codes and standards.

1. Hydraulic Institute (HI)
2. American Iron and Steel Institute (AISI)
3. American National Standards Institute (ANSI)
4. American Society of Testing and Materials (ASTM)
5. American Water Works Association (AWWA)
6. International Organization for Standardization (ISO)
7. Anti-friction Bearing Manufacturers Association (AFBMA)

1.05 SUBMITTALS

A. GENERAL

1. Submit shop drawings, including related details and data, in accordance with the below.
 2. The Contractor shall make a complete and acceptable submittal to the Owner, as determined by the Engineer, by the second submission.
 3. The Owner reserves the right to withhold monies due the Contractor to cover additional costs of the Owner's review beyond the second submission.
- B. PUMP DATA AND CALCULATIONS: Submit necessary data and calculations to demonstrate full compliance with the specification requirements, including, but not limited to:
1. Column and head losses, thrust data, Critical Speed calculations, etc. The critical speed calculations shall be by the pump manufacturer for both lateral and torsional analysis to identify and ensure that the first lateral critical speed shall be at least 25% above the maximum speed and that no torsional natural frequencies occur within the range extending 25% below to 25% above the specified operating speed range and than any blade excited resonant frequency shall be no closer than plus or minus 25% of the natural frequency of any part of the installed assembled pumping unit. Calculations must be submitted to the contractor and approved by the engineer prior to the manufacturer assembling the pump. Critical speed analysis shall meet HI standards.
 2. Provide a detailed description of all pump materials and parts as well as detailed fabrication drawings. Submit details of fabricated steel discharge head and provide written certification from pump manufacturer that the discharge head has the capability of accommodating the specified drives and the design column length within acceptable vibration limits.
 3. Provide statement by Pump Manufacturer specifying the "Allowable Operating Range" as defined by the HI Standards and AWWA E-103 Standard.
 4. The Contractor shall submit certified pump curves based upon factory testing by the pump manufacturer for approval by the Owner, for each pumping unit to be furnished herein; showing head versus capacity, bowl efficiency versus capacity; and typical NPSHR. Each curve shall be continuous over the full operating range from zero (0) flow up to the maximum flow permissible through each pump, and each curve shall be based upon the RPM listed herein. For variable speed operation, include curve for operation at the specified minimum RPM and intermediate RPM values. Each curve shall state the RPM speed of the pumping unit, and shall be furnished full-size on 8 1/2" x 11" paper. Submit calculations and written certification from pump manufacturer that the pump furnished herein will operate compatible with the Net Positive Suction Head (NPSH) available
 5. The Contractor shall provide pumps capable of meeting all aspects of the Pumping Unit Design Data section herein (Par. 2.03 & 2.04) and as shown on the Drawings.
- C. PUMPING UNIT OUTLINE DIAGRAMS: Before the manufacture of the pumping units and appurtenances is commenced, the Contractor shall submit to the Owner for approval, detailed fabrication drawings of said pumping unit material.
- D. NPSH REQUIREMENTS: Submit calculations and written certification from pump manufacturer that the pump furnished herein will operate compatible with the Net Positive Suction Head (NPSH) available.

- E. DISCHARGE HEAD: Submit details of fabricated steel discharge head and provide written certification from pump manufacturer that the discharge head has the capability of accommodating the specified drives and the design column length within acceptable vibration limits.
 - F. COATINGS: Provide coating manufacturer's information and data for fusion bonded epoxy lining and coating.
 - G. FIELD PROCEDURES: Submit detailed field procedure for installation, adjustment, inspection, and testing of all pumping equipment.
 - H. TEST PROCEDURES: Pump manufacturer shall submit shop testing procedures at least thirty (30) days prior to the test.
 - I. OPERATION AND MAINTENANCE INSTRUCTIONS: Complete and detailed operation and maintenance instructions shall be submitted in accordance with the Special Requirements.
- 1.06 QUALITY ASSURANCE
- A. MANUFACTURER'S EXPERIENCE – GENERAL:
 - 1. Manufacturer of the Pumping Equipment specified in this section shall have experience in providing similar type equipment.
 - 2. If required by Engineer or Owner, manufacturers shall show evidence with his submittal of at least five (5) installations where equipment of the same material and same application of the type specified herein have been in satisfactory operation for at least five (5) years.
 - B. PERFORMANCE AND ACCEPTANCE TESTING: After completion of the facility, acceptance testing of the pumping units shall be performed in accordance with Par. 3.03 herein.
 - C. NON-APPROVED PUMP MANUFACTURER:
 - 1. Submission of a non-approved manufacturer may be subject to rejection.
 - 2. Authority for determination of "approved equal" pump and manufacturer, including conformance with Specification requirements, shall rest solely with the Owner.
 - 3. In the event that the Contractor's submission of an alternate pump selection and manufacturer is rejected, Contractor shall submit the specified pump and manufacturer at no additional cost to the Owner.
 - 4. No additional contract time extension will be granted for the Owner's review and evaluation.
 - D. POTENTIAL REQUIRED REVISIONS TO STRUCTURES:
 - 1. Should the equipment selected by the Contractor require revisions to the structures, piping, electrical, or other work shown on the drawings, the Contractor shall include the cost of such revisions in his bid for the equipment, and no extra payment shall be made for such revisions.
 - 2. All such revisions shall be submitted for Owner approval and shall be subject to the approval of the Owner.
- 1.07 SYSTEM START-UP

- A. Contractor shall provide system start-up and testing. The Pump Manufacturer or Approved Representative shall furnish the services of a qualified field engineer to check installation, start-up and instruct Owner operating personnel in the proper operation and maintenance of the equipment. Refer to Par. 3.04 herein.

1.08 CERTIFICATION OF INSTALLATION

- A. The Contractor shall submit a letter to the Owner confirming that all pumping equipment was inspected, operation checked, and installation approved in writing by the respective Pump Manufacturer and the Contractor. The letter shall be included with the warranty described in Section 1.10 herein; and an executed "Certification of Proper Installation" from the manufacturer shall be provided. The form is included in the appendix of these specifications.

1.09 WARRANTY

- A. All pumping equipment shall carry a warranty for a one-year period from the date of start up, All warranties shall be turned into the Owner prior to project completion.

PART 2 - PRODUCTS

2.01 PUMP CONSTRUCTION

A. PUMP BOWLS:

1. The bowls shall be of close-grained, gray cast iron, Class 30 or better, precision cast, free from blow holes, sand pockets, and other detrimental defects.
2. The water passageways in said bowls shall be smooth so as to allow freedom from cavitation and permit maximum efficiency.
3. Each bowl shall have a rubber lateral seal ring and a side seal to prevent slippage of water between bowl and impeller. .
4. In order to improve the guaranteed efficiency at the design point(s), lined bowls shall be furnished.
 - a. Said lining, vitreous porcelain enamel or equal, shall be of such material and applied in such manner to produce a long effective life which and shall not be applied for the purpose of a short time gain in efficiency.
 - b. Lining, identical to that furnished hereunder, shall have been used in the field, under identical conditions, with satisfactory results for at least a five-year period. Lining shall be NSF 600 certified.
5. The outside diameter of the bowls shall be of such size to fit the suction can ID, with proper clearances while maintaining maximum velocity of less than 5 FPS between the pump can and bell, flange or coupling..

6. The bowl design pressure shall be a minimum of 3 1/2 times the maximum pump shut-off head (zero flow).
7. The exterior surfaces of the bowl assembly shall be coated with fusion-bonded epoxy lined and coated with 3M Scotchkote 134 or approved equal with thickness and application procedures per paint manufacturer's published instructions.

B. PUMP IMPELLERS:

1. The impellers shall be of the enclosed type, constructed of de-zincification resistant alloy or 316 SS.
2. They shall be balanced hydraulically and dynamically to prevent vibration and shall be smoothly finished on all surfaces to reduce friction losses to a minimum. Dual plane balance to G6.3.
3. The impellers shall be accurately fitted and securely locked to the pump shaft, and vertical adjustment of the impellers shall be possible by means of an adjustment method in the driver assembly.

C. KEYED IMPELLERS: The impellers shall be accurately fitted and securely locked to the pump shaft, and vertical adjustment of the impellers shall be possible by means of an adjustment method in the driver assembly. The split rings and keys shall be constructed of 316SS.

D. PUMP SHAFT:

1. The pump shaft shall be constructed 416 Stainless Steel and shall be accurately machined to a sufficient dimension to provide smooth operation and to easily withstand torsional loads and other stresses encountered within the pump as calculated per AWWA E-103.
2. The pump shaft shall have adequate bearing support at every bowl section and at the top and bottom case section and shall be equipped with a suitable 410 SS threaded coupling for connection to the line shaft.

E. PUMP BEARINGS:

1. The suction case section and the discharge case section shall be sleeve type constructed of bismuth tin bronze.
2. The bowl bearings shall be dual bushed sleeve type of bismuth tin bronze and rubber, or equal as approved by the engineer.
3. Bearing area, bearing cooling, and bearing lubrication shall be ample for long trouble-free operating life of the equipment.

F. PUMP SUCTION BELL: A suction bell constructed of class 30 CI shall be provided, with entrance vanes so designed to allow even flow of water into the pump. 316SS.

G. PIPE COLUMN:

1. The column shall be flanged. Hardware shall be 316 Stainless Steel

2. The ends of the pipe section shall be faced parallel and machined to insure proper alignment when assembled.
3. Bearing spacing shall be no longer than 5 feet.
4. Intermediate connections to have a removeable 304 SS bearing retainer and a Rubber bearing.
5. The exterior and interior surfaces of all column pipe shall be coated with fusion-bonded epoxy lined and coated with 3M Scotchkote 134 or approved equal with thickness and application procedures per paint manufacturer's published instructions
6. Lining/coating shall be NSF 600 certified.

H. PUMP DISCHARGE HEAD ASSEMBLY:

1. The pump discharge head shall be of fabricated steel and shall be arranged for mounting, for connecting top column pipe, for connecting to the top of the sole plate, and containing an above ground flanged discharge outlet. A 304 SS sole plate shall be supplied for each pump.
2. A packing gland assembly and packing shall be supplied.
3. The exterior and interior surfaces of the discharge head shall be fusion-bonded epoxy lined and coated with 3M Scotchkote 134 or approved equal with thickness and application procedures per paint manufacturer's published instructions.

I. PUMP LINE SHAFT ASSEMBLY:

1. A line shaft shall be supplied, of Type 416 SS material, or equal as approved by the Engineer, and shall conform to AWWA E-103.
2. Threaded shaft couplings of 410 SS shall be provided at all shaft connections.

J. PUMP NAMEPLATE:

1. The pump shall be provided with an easy to read, stainless steel nameplate.
2. It shall contain complete pump information including: pump manufacturer's name, serial number, pump model number, number of stages, speed, TDH and capacity in GPM at the middle design point, etc.
3. Said nameplate shall be mounted on the pump head.

- K. L. A 316 Stainless Steel vortex suppressor shall be provided and attached to the suction bell of the pump in order to prevent excessive turbulence in the water as it passes from the suction inlet pipe into the suction can, down between the bowl assembly and the suction can, and into the suction bell of the pump.

L. M. MOTORS:

1. Provide vertical, flange mounted, hollow shaft motors with weather protected WP-1 type enclosure.
2. Motors are to operate on 480v, 3 phase, 60 Hz power.
3. Motors are to be inverter duty rated and shall operate of of VFD controls
4. Motors shall have 120v space heaters.
5. Motor winding thermal protection system shall be provided for protection against thermal overload, high ambient temperature, abnormal voltage, ventilation failure and voltage imbalance. Motor RTDs shall be 200 ohm platinum and shall be wired to the starter controls to shutdown the motor on high temp conditions. Provide one RTD per winding.
6. Motor service factor shall be 1.15.
7. Motor shall have non reverse ratchets.
8. Motor thrust bearings shall be normal thrust capacity. Bearings shall have a normal B-10 life of 50,000 hours.
9. Upper and lower bearings shall each have a 100 ohm platinum RTD for monitoring bearing temperature and shall be wired to the motor starter controls to shutdown over high bearing temp.
10. Lubrication of the motors shall be the manufacturers standard and all lubricants shall be provided by the contractor. This includes oil and grease lubricants.
11. Motor windings shall be copper.

2.02 SPARE PARTS

- A. Each pump shall be furnished with the following spare parts:
 1. One (1) set of all bowl bearings
 2. One (1) set of all wear rings
 3. One (1) set of all pump shaft bearings
 4. One (1) set of all gaskets and O-rings
 5. Include any special tools required for normal maintenance
- B. All spare parts furnished shall be identical and interchangeable with the original parts furnished in clearly identifiable and labeled containers.

2.03 PUMPING UNIT DESIGN DATA – HIGH SERVICE PUMP

- A. GENERAL – High Service pump: The pumping units shall be furnished in accordance with the design data described herein. The pump driver shall be 250 HP motor in accordance with the electric motor specifications.
- B. Quantity: 4

C. DESIGN DATA: The pumping units shall be furnished in accordance with the following:

1. Motor: 250 HP, 460 V WP1 enclosure, 6 pole speed, 3 phase, 60 Hz, inverter duty rated.
2. Discharge Head: 12x12x20 FRA fabricated steel; 12" dia. ASA 150# lb. discharge flange.
3. Column: 12" dia.
4. Line Shaft: 1.69" dia. min.
5. Bowl Assembly: Nominal 18" dia. bowl (17.5" O.D.); 3 stages; 1770 RPM
6. Suction Bell: 18.50" O.D.
7. Pump: Floway 16DKL, or Peerless ; 2 stages; premium efficiency (hand polished),

D. OPERATING CONDITIONS:

1. Operating Conditions:
 - a. Pump Design Points Min. Bowl Lab Efficiency
 - b. 3,500 GPM @ 188 feet 83%
2. Shut-off Head: 330'

2.04 PUMPING UNIT DESIGN DATA – BACKWASH PUMP

A. GENERAL – Backwash pump: The pumping units shall be furnished in accordance with the design data described herein. The pump driver shall be 50 HP motor in accordance with the electric motor specifications.

B. Quantity: 2

C. DESIGN DATA: The pumping units shall be furnished in accordance with the following:

1. Motor: 50 HP, 460 V WP1 enclosure, 6 pole speed, 3 3 phase, 60 Hz, inverter duty rated.
2. Discharge Head: 12x12x20 FRA fabricated steel; 12" dia. ASA 150# lb. discharge flange.
3. Column: 12" dia.
4. Line Shaft: 1.25" dia. min.
5. Bowl Assembly: Nominal 12" dia. bowl (12.6" O.D.); 1 stage; 1180 RPM
6. Suction Bell: 23.50" O.D.
7. Pump: Floway 19FKM or Peerless 1 stage; premium efficiency (hand polished),

D. OPERATING CONDITIONS:

1. Operating Conditions:

- a. Pump Design Points Min. Bowl Lab Efficiency
 - b. 3,600 GPM @ 40 feet 79%
- 2. Shut-off Head: 70.7

PART 3 - EXECUTION

3.01 INSTALLATION

- A. GENERAL: Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as indicated on the Contract Drawings, unless otherwise approved by the Owner.
- B. ALIGNMENT: Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, vibration, shaft run-out or other defects. Equipment shall be secured in position and fixed neatly in appearance. Pumping unit shall be within 0.005" per foot of level at discharge head base.
- C. COATING: All exposed materials except corrosion-resistant metals which have not been shop painted shall be field coated as specified (Protective Coating). Shop painted items which have been damaged during transport and/or installation, shall be touched up per specifications and as approved by Inspector.
- D. PUMP PEDESTAL: The pump station construction Contractor shall furnish and install the reinforced concrete pedestal and all necessary embedment and support items as described on the Specifications and Contract Drawings.
- E. COORDINATION: The pump station construction Contractor will be responsible for coordinating all applicable aspects of the project with the pump and motor supplier including, but not limited to equipment installation procedures and requirements, specific materials to be furnished, scheduling of materials deliveries, overall construction schedule, equipment storage and protection requirements, and equipment testing requirements. The required coordination, including implementation of pump manufacturer's requirements as related to the equipment furnished, shall be included in the construction Contractor's bid price(s), and no additional compensation shall be made therefore.

3.02 FACTORY PUMP TESTS

- A. GENERAL:
 - 1. Pump(s) shall undergo factory non- witnessed pump testing.
 - 2. Tests shall be performed in accordance with the applicable standards in the Hydraulic Institute.
 - 3. The acceptance test shall be per Hydraulic Institute Acceptance grade 1U; with no minus tolerance on efficiency
 - 4. To successfully pass a laboratory performance test, a pumping unit shall meet all performance requirements specified.

- B. NON-COMPLIANCE: Should results of the test indicate, in the opinion of the Engineer, that the pumps fail to meet any of the specified requirements, the Owner will notify the Contractor of such failure. The manufacturer shall thereupon, at no expense to the Owner, make such modifications and perform additional testing as may be necessary to comply with these specifications.

3.03 FIELD ACCEPTANCE TEST RESPONSIBILITY

- A. GENERAL: The Contractor under this specification shall have full responsibility for the proper installation and performance of said pumping equipment, including furnishing the services of a pumping equipment field Service Engineer to inspect during equipment installation, and to adjust, if necessary, any portion of the pumping equipment required herein.
- B. TESTING AND PERFORMANCE: The Contractor's Field Service Engineer (Pump Manufacturer) shall be responsible for the pumping unit field acceptance tests. The pump unit(s) shall perform in the field substantially as shown on the certified pump curves furnished by the Contractor after reasonable allowances for field conditions. The head capacity, input horsepower, and overall efficiency values will be determined for at least three points in the stated operating range of the pump, and will be compared with the certified curves.
- C. FIELD TEST DOCUMENTATION: Field Service Engineer for Pump Manufacturer shall provide documentation to Engineer (including "Certification of Proper Installation") for all field adjustments made and tests performed.
- D. NON-COMPLIANCE: In the event that the tests reveal noncompliance of the workmanship or equipment with these specifications, the Contractor shall be required to perform, at his own expense, such work and furnish materials as will, in the opinion of the Engineer, restore the equipment to the specified performance.

3.04 SERVICES OF MANUFACTURER

- A. GENERAL: The services described herein are for field installation and field acceptance testing as described in Par. 3.03 herein. For purposes of this paragraph, a work day is defined as an 8-hour period at the site, excluding travel time. The Owner may require that the manufacturer's services described herein be furnished in three (3) separate trips.
- B. INSPECTION, STARTUP AND FIELD ADJUSTMENT: The service representative of the manufacturer (Field Service Engineer) shall be present at the site for a minimum of two (2) work days.
- C. INSTRUCTION OF OWNER'S PERSONNEL: The training representative of the manufacturer shall be present at the site for one (1) work day to instruct Owner personnel on the operation and maintenance of the pump equipment.

END OF SECTION

SECTION 46 05 00

COMMON WORK RESULTS FOR WATER EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes the basic requirements for water treatment equipment, general installation requirements, equipment identification, equipment protection, maintenance access requirements, training requirements, and testing and startup procedures,

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 01 79 00 - Demonstration and Training
 - 3. Section 09 91 00 – Painting
 - 4. Section 40 05 00 - Common Work Results for Process Interconnections
 - 5. Division 26 - Electrical

1.03 REFERENCES

- A. American Bearing Manufacturers Association (ABMA)
- B. American Gear Manufacturers Association (AGMA)
- C. American Society for Testing and Materials (ASTM):
 - 1. ASTM A276 - Standard Specification for Stainless Steel Bars
 - 2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings
- D. Hydraulic Institute Standards
- E. National Electrical Manufacturers Association (NEMA)

1.04 SUBMITTALS

- A. Each manufacturer furnishing equipment shall submit the following information to the Engineer for approval in accordance with the requirements of Section 01 33 00 Submittal Procedures.
 - 1. Shop drawings, working drawings, certified drawings, guaranteed performance curves, wiring diagrams, specifications, and lists of electrical controls, including manufacturer's

name and catalog number, horsepower, and normal full load maximum load ampere rating of each motor

2. Estimated weight of each unit
3. Sets of certified test curves for each pump with capacity of greater than 100 gpm prior to shipment in accordance with the General Requirements section of these Specifications
4. List spare parts and tools furnished with equipment. Unless otherwise specified herein, tools shall be only such special tools required by the equipment.

1.05 WARRANTY

- A. Manufacturer's standard warranty, minimum 1 year from start-up, with extended warranties as specified in individual sections.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Manufacturer:

1. Any reference to an item of equipment or material by a specific manufacturer's trade name in these Specifications is intended merely as a standard. Even though named in the Specifications, equipment offered with smaller or lightweight mechanism or devices compared to that specified will not be approved for the project. Each bidder is required to state his bid price for that item as required in the Proposal. This requirement is to prevent rejection of the bid should a piece of substitute equipment be rejected. Other equipment shall be considered as specified in the "General Conditions" if offered by the bidder under "Substitute Equipment" in the Proposal; provided, it is equal in functional design, mechanical and structural details to the one specified.

B. Substitute Equipment

1. Refer to Section 01 25 00 Substitution Procedures

C. Standardization:

1. To avoid a division of responsibility among several manufacturers for items of equipment having functions related to each other or to the same portion of the treatment process, and to avoid unnecessary duplication of replacement parts and service calls by the Owner, the equipment supplied under any numbered paragraph shall be the product of or furnished and guaranteed by one (1) manufacturer unless otherwise permitted herein.

D. Equipment Obtained from Equipment Manufacturer:

1. The Contractor shall obtain all equipment specified and required for the safe operation and use of that equipment from the manufacturer or the equipment unless excluded by provisions in this paragraph or specifications for the item.
2. Unless otherwise stated in the Specifications, the following type of materials shall not be considered to be a part of the equipment: connecting piping and valves, railing set in the

tank or structure, motor starters and wiring, steps and manholes installed separately from equipment, finish painting, etc.

2.02 EQUIPMENT BASEPLATES

- A. Mount the equipment on a common baseplate arranged compactly unless otherwise specified.
- B. Construct the baseplates from heavy cast iron or welded structural steel sections with a minimum thickness of ½ inch. Ensure structural steel baseplates are adequately stiffened to prevent resonance and absorb vibration from the equipment.
- C. Provide closed baseplates designed for grouting, including grout holes, vent holes, and anchor bolt holes.
- D. For equipment prone to leakage or condensation, use baseplates with a drip lip a minimum of 1.5 inch high around the exterior. Include bossed drain connections below the gutter invert, with a minimum size of 1 inch NPT. Route piping from the drain connections to the building drainage system.

2.03 FLANGES

- A. For equipment, valves, and devices with integrally cast flanges, ensure the flanges conform to the dimensions and drilling specifications of ANSI B16.1 or ANSI B16.5, with bolt holes aligned to straddle the vertical centerline.
- B. Orient all flanges so that their bolt holes straddle the vertical centerline.
- C. Finish flanges in accordance with MSS Standard Practice SP-6.

2.04 MOTORS

- A. Motors for operating mechanical equipment shall satisfy the latest requirements of the Institute of Electrical and Electronic Engineers, American National Standards Institute, and the National Electrical Manufacturer's Association. Motors shall be manufactured by Weg, Baldor, NIDEC, or equal. All single and 3-phase motors (except fan motors which may be of an approved manufacturer standard) shall be ball bearing, and have either SEALED IN lubricant or be designed for external oil or grease lubrication. The equipment manufacturer shall supply motors having sufficient torque to start equipment under load and to accelerate the equipment smoothly and quickly to full speed without exceeding the motor nameplate ratings, including service factor. Motors, except totally enclosed motors, shall have 1.15 service factor, unless otherwise specified.
- B. Motors 25 horsepower and larger shall be equipped with embedded stator thermostats (normally closed) connected internally in series and brought out through motor junction box for connection to starter pilot relay 115V control circuit. Large motor protection will be covered under the paragraph applying to the individual motor.
- C. Motors ½ horsepower and larger shall be 3-phase, 60 hertz, induction type and be designed for full voltage starting. Motors shall have either 40°C rise Class insulation or 60°C rise Class B insulation, be open drip-proof for indoor installation, be vertical splash-proof and drip-proof for outdoor installation or have 70°C Class B rating rise for totally enclosed, non-ventilated, outdoor, horizontal installation.

- D. Motors smaller than ½ horsepower shall be single phase, induction, capacitor-run type, unless otherwise specified. Very small motors and those for special purposes may be shaded pole type subject to approval by the Engineer.

2.05 EQUIPMENT NAMEPLATES

- A. Securely attach corrosion-resistant metal nameplates with engraved or embossed lettering to the equipment in a location that is easy to read. The nameplates shall include the following information:
- B. For pumps and mixers, etc.
 - 1. Model number
 - 2. Serial Number
 - 3. Capacity
 - 4. Head
 - 5. Impeller diameter

2.06 COATINGS

- A. Provide the factory applied coating specified in the Equipment Specifications, where a coating system is not specified provide a factory applied primer compatible with painting systems specified in the Painting Section 09 91 00.
- B. A field applied finished coating shall be applied to the equipment per Painting Section 09 91 00.

PART 3 - EXECUTION

3.01 TESTING

- A. After each unit has been installed and is ready for operation, it shall be operated continuously for a period of 24 hours. During that period, the equipment will be inspected for defects and weakness. Parts of the unit which show a defect and/or a weakness shall at once be removed and be replaced with new parts or be made good in a satisfactory manner at no additional expense to the Owner.
- B. Continuous 24-hour test shall be made after all defects have been remedied at no additional expense to the Owner.
- C. After installation and final testing, each equipment manufacturer furnishing supervision and/or inspection services shall make written certification to the Engineer and the Owner that the equipment and controls have been properly installed in accord with the Drawings, Specifications and manufacturer's requirements and that the required operating and maintenance instructions have been furnished to the Engineer.
- D. The equipment manufacturer shall schedule a training session for the plant operators with the Owner and Engineer. This session shall be conducted by an equipment representative experienced in all aspects of the equipment. The session will as a minimum discuss the operation and maintenance items required to operate the equipment. In addition, replacement parts, anticipated

life, etc., and a complete overview of the Operation and Maintenance Manual shall be discussed. The session shall be onsite at the equipment and in the plant conference room.

3.02 PIPING CONNECTIONS

- A. Refer to Section 40 05 00 Common Work Results for Process Piping Interconnections
- B. The Contractor shall furnish completely dimensioned layouts for all piping, fittings, valves, specialties and other equipment. Deviations from the dimensions shown on the Drawings, caused by equipment dimensions, shall be taken into consideration by the Contractor, and changes in piping, electrical conduit and other similar items shall be done at no additional expense to the Owner.

3.03 OPERATION AND MAINTENANCE MANUALS:

- A. Before the equipment is placed in service, operation and maintenance manuals for the equipment, clean and unused, shall be delivered to the Engineer by the Contractor in accordance with Section 01 33 00 of these Specifications.

3.04 SPARE PARTS AND ALLOWANCE:

- A. The Contractor shall allow \$10,000.00 in his bid for spare parts in addition to the spare parts specified in each mechanical equipment section for individual pieces of equipment. The Contractor shall submit a list of additional spare parts recommended by each manufacturer along with a price list for the Engineer's approval. The spare part list shall be provided as specified in the General Requirements section of these Specifications.

3.05 STARTUP AND COMMISSIONING

- A. Refer to the specified equipment start-up requirements as well as Section 01 79 00, Demonstration and Training.

END OF SECTION

SECTION 46 31 43

REMINERALIZATION SYSTEM

PART 1 - GENERAL

1.01 SCOPE

- A. The Manufacturer shall furnish Remineralization technology as specified herein and shown on the drawings. The Remineralization Process includes adding CO₂ and lime slurry followed by mixing. The Manufacturer will provide the manufacturer's Lime Slurry Storage and Feed system and the Manufacturer's CO₂ Storage and Feed System as subsystems. The equipment shall be fabricated, erected, assembled, and placed in proper operating condition in full conformity with the drawings, specifications, instructions, and recommendations of the equipment manufacturer. Each subsystem of the remineralization system shall be as manufactured by Burnett Lime Company, Inc.

1.02 MANUFACTURER

- A. Each subsystem of the remineralization system shall be as manufactured by Burnett Lime Company, Inc. a functioning, integrated package. The system manufacturer shall take sole responsibility for the products incorporated in the package.

1.03 PROCESS DESCRIPTION

- A. The RE~MIN PROCESS® US PATENTED includes three process steps:
 - 1. CO₂ injection occurs in a closed water line. There may be one or more CO₂ injection heads in each water line depending on the pipe diameter or dosage requirements followed by static mixing.
 - 2. The NSF/ANSI/CAN 61 Certified CAL~FLO® Lime Slurry System shall add CAL~FLO® Lime Slurry to the water.
 - 3. Water passes through any form of mixing. This includes but is not limited to Static Mixer, Mechanical Mixer, Turbulence from 90 Degree elbow, etc.

A PROCESS RECOMMENDATIONS AND REQUIREMENTS

- B. Burnett Lime Company, Inc. requires the following criteria be met when designing/installing RE~MIN PROCESS® technology:
 - 1. CO₂ injection is to take place in a closed water line that is completely filled with water approximately 15 feet prior to the lime slurry feed, followed by mixing. CO₂ must not be injected into the standing water of a clear well, ground storage, open-air tank, or open water line.
 - 2. The CAL~FLO® Lime Slurry injection is recommended to be added prior to the intake of complete mixing.

1.04 LIME SLURRY SYSTEM

- A. The manufacturer shall furnish and install of one complete lime slurry storage and feed system as specified herein and as shown on the drawings. The equipment shall be fabricated, erected, assembled, and placed in proper operating condition in full conformity with the drawings, specifications, instructions, and recommendations of the equipment manufacturer. The system shall be as manufactured by Burnett Lime Company, Inc.

1.05 MANUFACTURER

- A. The lime slurry chemical system manufacturer/supplier shall be Burnett Lime Company, Inc., (hereafter referred to as Burnett) in Campobello, South Carolina. The entire lime slurry chemical system will be designed, coordinated, and supplied by one manufacturer. The system manufacturer shall furnish all equipment to complete a functioning, integrated package. The system manufacturer shall take sole responsibility for procurement, installation, and testing of the products incorporated in the package.

1.06 QUALIFICATIONS

- A. The equipment manufacturer of the lime slurry chemical system shall be one who is regularly engaged in the business of designing and building chemical handling systems. Manufacturers not named in this specification shall verify their qualifications for designing, furnishing, and coordinating the chemical system by furnishing the Owner, prior to the bid date, information meeting the criteria listed below:
 - 1. The equipment manufacturer shall have the required financial capability to complete the project.
 - 2. The equipment manufacturer shall furnish names of manufacturers whose products are normally supplied and the type of business relationship with each.
 - 3. The equipment manufacturer shall maintain a qualified technical and design office.
 - 4. The equipment manufacturer shall have a physical plant and personnel to complete the work specified.
 - 5. The equipment manufacturer shall maintain competent service personnel to service the equipment furnished.
 - 6. The equipment manufacturer shall have successfully provided similar work for at least five years.
 - 7. The equipment manufacturer shall furnish at least five references who are users of similar systems designed, fabricated, and furnished by the equipment supplier.
 - 8. The manufacturer must have the capability to install a pilot test unit in order to provide functional data to prove system claim and complete a successful on-site plant trial prior to bidding.
 - 9. The slurry system shall be NSF/ANSI/CAN 61 certified.

PART 2 - PRODUCTS

2.01 LIME SLURRY SYSTEM PROJECT DESCRIPTION

- A. Burnett proposes to provide a CAL~FLO® Standard Lime Slurry Storage and Delivery System. The system consists of one 16,000-gallon tank and a pump and control building. The pump and control building contains the feed pumps, electrical and control panels, and other functional components of the system. The pump and control building is preassembled to the extent possible and factory tested at our manufacturing facility prior to shipping. The pump and control building will hereby be referred to as the “building”.
1. The tank will be shipped directly from the manufacturer, received by Burnett in coordination with the Pump and Control Enclosure, and set on the concrete pad provided by the Owner/General Contractor.
 2. The building will be transported to the site by Burnett technicians and set into place in conjunction with and connected to the storage tank.
 3. Burnett’s installation and startup technicians will provide all final terminations and system extensions.
 4. Burnett will provide both startup and technical training for the operators. Specific operational procedures, reporting, and safety training will be the responsibility of the Owner.

2.02 LIME SLURRY TANK

- A. Tank with baffles shall be a single compartment, welded steel reinforced top, having a nominal capacity of 16,000 gallons and a maximum diameter of 12 feet.
- B. The tank shall be fabricated using steel as specified by ASTM A36.
- C. Tank design shall be in accordance with AWWA D100 with a minimum top and bottom plate thickness of 1/4-inch and minimum wall plate thickness of 1/4-inch.
- D. Tank appurtenances shall be as follows:
1. 12-inch mixer mounting nozzle (top)
 2. 24-inch atmospheric manhole / inspection port (top)
 3. 24-inch manhole (3-1/2 feet above bottom)
 4. Four 6-inch nozzle (pump suction, 9-inches above bottom)
 5. 3-inch nozzle (drain, 2-inches above bottom)
 6. 4-inch threaded connection (overflow, 6-inches below top)
 7. 2-inch nozzle (spare, top)
 8. 6-inch nozzle (level sensor – 18-inches off the wall, top)
 9. 2-inch nozzle (water fill, top)
 10. 2-inch nozzle (slurry fill, top)
 11. 3-inch nozzle (re-circulation)

12. Six anchor lugs
13. Ladder, ladder cage, and full tank perimeter handrail (carbon steel)
14. Standoff pipe supports and clamps (maximum 8 feet on center for overflow, slurry, and water lines)
15. Two lift lugs
16. 2-inch fill pipe with quick-connect
17. 4-inch overflow pipe
18. Six 1-inch diameter stainless steel anchors furnished and installed by Burnett

E. Surface Preparation and Painting.

1. The exterior of the tank dome, wall, and appurtenances shall be prepared by commercial sandblast followed by one coat of MoPoxYTM ST High Solids Epoxy Coating 41-series: component A - 41-BK-1 and component B - A41-EF-3 by Tank Manufacturer. Field painting, by the General Contractor, of the exterior dome and wall, shall be one coat of H2O RUS-KIL® ACRYLIC DTM Rust Resistant Primer 310 series: #310-08 and one finish coat of H2O RUS-KIL® ACRYLIC DTM Rust Resistant Coating #310-series: #310-16.
2. The Tank Manufacturer shall coat the bottom of the tank with coal tar epoxy.

2.03 PUMP AND CONTROL BUILDING

- A. The building shall be a nominal 10'-4" x 11' metal building with the tank shell forming one wall. The minimum clear height of the building shall be 8'.
- B. The building shall be (Stainless Steel Frame 2" Square Tube) with 3" vinyl-backed insulation. The 26-gauge exterior wall panels, roof panels, and flashings shall be coated with a factory finish White Standard Semi-Gloss.
- C. The building accessories shall include:
 1. One 36-inch by 84-inch access door with stainless steel hardware.
 2. One 1500-watt UL-listed heater with thermostat/on-off switch as manufactured by Marley CZ1512-T.
 3. One 115-volt fan having a minimum free air capacity of 524 CFM. The fan shall be thermostatically controlled. The fan shall be fitted with a wire guard and a removable interior vent door. Provide manually adjustable FRP air intake vent with FRP screen. The exhaust fan shall be Dayton Model 1BLH6.
 4. Interior lighting shall be by one, 4-foot long, surface-mounted fixture controlled by a weatherproof interior switch.
 5. Provide one 120-volt interior GFI Type outlet with a gasketed, spring-loaded cover.
 6. All lighting, heater, ventilation, switches, and outlets shall be pre-wired using 3-wire, color-coded, #12 THHN copper wire in PVC Schedule 80 conduit.

- D. Provide lime system tank and building with grounding lugs.

2.04 LIME SYSTEM CONTROL PANEL (LCP-LS-1)

- A. All motor starters, relays, timers, and devices for the control and operation of the equipment shall be housed in a control panel mounted in the building. A PLC within the Lime System control panel shall provide a remote signal/equipment interface for both the lime system and the CO₂ system with the plant system via Owner/Contractor provided Ethernet cable.
- B. The CAL~FLO® Lime Slurry system with PLC is designed to be a stand-alone manually operated self-contained lime delivery system or may be remotely operated from a plant SCADA System via Ethernet cable provided by the Owner/General Contractor to the Burnett supplied Allen-Bradley CompactLogix™ PLC. A list of addresses will be provided to the HMI programmer for status display/control. Remote input to the lime system is necessary for the stroke adjustment (0-100%). This stroke adjustment is generally calculated by the plant's own supervisory PLC/HMI system, based on flow rates, pH, anticipated lime needs, etc. as a 0-100% value of stroke adjustment. The CAL~FLO® Lime Slurry System PLC shall be CompactLogix™ L33ER as manufactured by Allen-Bradley.
- C. Power Supply: The Owner/General Contractor shall provide a 480 VAC, three-phase power feed to the flange-mounted circuit breaker located in the lime system control panel. All controls shall operate on 24 VDC maximum. A 3000 VA control power transformer with primary and secondary overcurrent protection will be provided.
- D. Panel: NEMA 4X 304 SS, bottom entry, flange-mounted disconnect. A grounding lug is provided within the panel to assure positive system ground.
- E. Components
 1. Circuit Breaker: Isolation Breaker for the Panel shall be a 60 Amp Type M breaker /ITED 43B060L or equal.
 2. Starters and Motor protection: Motors will be controlled and protected by Allen-Bradley Model 100-C and 140MT-C3, Type E self-protected manual starters with adjustable amperage breakers. Motor Protection shall conform to IEC Circuit Breaker requirements as defined by IEC 947-2 and UL/CSA listed.
 3. Relays: Relays shall be general-purpose control type, 10 amps, 600-volt reversible contacts. Relays shall be equal to Allen-Bradley Type 700H.
 4. Selectors: 30.5 mm, NEMA 4X rated; contacts shall be rated 10 amps continuous, 6 amps breakers at 24 VDC, manufactured by Allen-Bradley, Type 800H.
 5. Weatherproof Horn: Horn shall generate a loud audible alarm when activated by 24 VDC power. The horn shall surface mount with sealable side conduit entry and shall be rated for NEMA 4X. The horn shall be equal to Federal, Model 450E and will be mounted on the exterior of the building.
 6. Indicator Lights: Provide 30.5 mm transformer type LED indicator lights as equal to Allen-Bradley type 800H.
 - a. Green: Run

- b. Amber: Fault and Low Level
 - c. Red: High/Low Pressure, High Level, and Re-order
 - d. White: Power On
 - e. Blue: 120 VAC 24 VDC Power On
 - F. Panel Construction: Terminal strips will be numbered for all field-wiring terminations.
 - G. Engraved Nameplates: Engraved nameplates with white backgrounds and black letters on all front panel-mounted devices.
 - H. Surge Protection: AC power wiring shall be protected against lightning spikes and other transient surges at the control panel. Protection shall be as manufactured by Siemens TPS series.
 - I. Cater pump control shall be provided for managing the high and low-pressure status of each lime slurry pump. A red indicator light for high-/low-pressure alarm and the Red Lion digital readout are located on the door of the lime control panel LCP-LS-1. Pressure shall be read by the system PLC.
- 2.05 LEVEL INDICATOR TRANSMITTER (LIT-1)
- A. Lime level control shall be the Milltronics MultiRanger tank level transmitter and indicator. The level indicator will be utilized to produce an audible high-level alarm located on the exterior of the building and re-order, high level, low level, and indicator lights are located on the exterior of the system control panel. Level signal may be obtained by the plant supervisory system through the lime system PLC.
 - B. Panel Enclosure shall be a polycarbonate enclosure rated NEMA 4X located in the building.
- 2.06 TANK MIXER
- A. The tank mixer shall be vertical, flange mounted with two axial flow and one radial flow impeller sized and positioned to maintain a homogenous mixture of up to 30% Lime Slurry at ambient temperature. The mixer shall be suitable for operation in a 12' diameter by 19' straight shell atmospheric tank.
 - B. The motor shall be furnished by Tesco, Inc. specifically for direct mounting to a gear reducer. Motor shall be TEFC, with a severe duty canopy, having the following characteristics:
 - 1. Horsepower: 7.5
 - 2. Maximum Speed: 1750 rpm
 - 3. 460 volt, 3-phase, 60 Hz
 - 4. Continuous Duty
 - C. A local mixer disconnect switch is located within visible sight of the mixer motor and the top entrance manway to the tank. All tank-mounted conduit shall be PVC schedule 80.
 - D. The speed reducer shall be designated for mixing service and operation in an outdoor environment.

- E. The speed reducer shall be constructed and supported so that the shaft deflection, caused by operation loads, does not affect the alignment of the anti-friction bearings or cause misalignment of gearing during mixer operation.
 - F. All reducer bearings shall be severe duty, anti-friction type, oil or grease lubricated. The speed reducer shall be splash lubricated, by means of gears or a slinger rotating on a horizontal shaft in an oil bath, to ensure positive displacement of the oil upward for lubrication of critical bearings. A single oil drain shall be provided at the low point of the speed reducer to allow oil drainage and leave a maximum residual of oil of no more than ¼-inch in the drive housing.
 - G. The shaft and impellers shall be carbon steel. The maximum operating speed of the unit shall be 0.5 times the natural frequency of the shaft and impeller assembly. The shaft diameter shall be determined by an analysis of torque and bending moment as well as critical speed. The minimum shaft diameter shall be 2.75-inch. The shaft supporting the turbine shall be removable from the speed reducer without disturbing the gears of the speed reducer using a rigid flange coupling on the impeller shaft.
 - H. The mixer shall be Tesco Model LSM-16-20 with Nord motor and gear reducer.
- 2.07 SLURRY METERING PUMPS
- A. Four Metering Pumps shall be a tubular diaphragm type, maximum rated delivery capacity of 34 GPH at 100 PSIG. Pumps shall have a minimum turndown ratio of 10 to 1 by variation of the stroke of the pump. Capacity shall be adjusted by manually changing piston stroke length or by automatic stroke adjustment.
 - B. For CAL~FLO® Lime Slurry Systems with a system PLC, the pump selector switch is placed in “Auto”, ready to receive a remote input signal (0-100%) from the remote plant integration system to the Lime system PLC via Ethernet interface provided by the Owner / General Contractor.
 - C. The CAL~FLO® system PLC shall send the 4-20 mA corresponding input to the metering pump to adjust the stroke length 0-100 percent and provide an output signal back to the CAL~FLO® System PLC for monitoring. Remote connection via Ethernet cable provided by Owner / General Contractor.
 - D. The motor shall be Baldor as required by pump size and shall have the following characteristics:
 - 1. Horsepower: 1/3
 - 2. 460 volt, 3-phase, 60 Hz
 - 3. TEFC: Continuous Duty
 - 4. Service Factor 1.15
 - E. Pumps shall be mounted on a steel base plate and secured to the floor of the building.
 - F. Pumps shall be Pulsafeeder Model PULSAPRO® 880.

2.08 CHEMICAL FEED LINES

- A. The slurry feed lines shall be accessible in a PVC conduit (conduit provided by the Owner/General Contractor). The feed tubing to the feed point shall be either 1/4", 3/8", 1/2", 5/8", or 3/4" ID clear flexible reinforced PVC hose and shall be equal to Kuri Tec Series #K3150 or Nylobrade®.

2.09 1.07 VALVES AND APPURTENANCES

- A. Water isolation valves shall be true union PVC ball valves.
- B. Automatic flush valves shall be true union 3-way actuated stainless steel ball valves.
- C. Provide one 3/4-inch hose bibb on the water supply header.
- D. Isolation valves for liquid lime service shall be 2-inch flanged pinch valves by ONYX Controls or equal. There are two limit switches on all pinch valves. One limit switch is interlocked in the pump run circuit to assure a positive position of the valve for pump protection. The second limit switch is to provide indication to the PLC.
- E. The water meter shall be a 2-inch, positive displacement AWWA approved water meter with pulse output. The water meter shall have a maximum range of 170 GPM.

2.10 INSTRUMENTATION

- A. Level transducer shall be 6-inch flange mounted, manufactured by Milltronics model XPS15. The level display Milltronics LT500 shall be mounted near the control panel.
- B. A pressure transducer /transmitter shall be as manufactured by Endress+Hauser and provided for each pump discharge line. Red Lion Indicators shall mount in the door of the control panel and receive the pressure signal.
- C. Dilution Water Control Panel (DWCP) shall be mounted near the water meter consisting of a NEMA 4X enclosure housing a Red Lion PAXI digital readout and a start/pause pushbutton Allen-Bradley Model 800H. Connection shall be made to the water meter. Note: The model numbers indicated above are to establish quality and Burnett reserves the right to provide equivalent components in the submission of the approval process.

2.11 SLURRY SPECIFICATIONS:

- A. Calcium hydroxide shall be a stabilized 30% aqueous suspension with a Specific Gravity between 1.19 and 1.23 g/ml. The Supplier shall certify no quicklime is used in the slurry manufacturing process and only finely ground air-classified hydrated lime for preparation of the slurry product. The slurry solids will have 99% or higher passing 100 mesh screen. Slurry product must be NSF/ANSI/CAN 60 certified. Delivery tankers shall be solely used for shipping slurry and equipped with a system to avoid spillage during the off-loading. The delivery driver shall be responsible for proper dilution and request inspection by the on-site operator. Generic lime slurries can have large particulates that would require costly removal from the system storage tank. The supplier will guarantee the function of the installed CAL~FLO® system from storage tank sediment and line stoppage with CAL~FLO® Slurry and the prior listed specifications. The warranty as described below is in lieu of any other guarantee, either expressed or implied. Burnett Lime Company, Inc.'s total liability under any circumstance shall not exceed the original purchase price of the equipment component in question and does not extend to any consequential damages or attorney fees that may result in the need for the replacement of nonconformity components.

2.12 BURNETT CO2 PROJECT DESCRIPTION

- A. Burnett proposes to provide one BURNETT CO2 System. The system is pre-assembled and factory tested at our manufacturing facility prior to shipping.
 - 1. The CO2 System will be shipped directly from the manufacturer, received by Burnett in coordination with the CO2 Control Panel, and set on the pad provided by the Owner/General Contractor.
 - 2. Burnett installation and startup technicians will provide all final terminations and system extensions.
 - 3. Burnett will provide both startup and technical training for the operators. Specific operational procedures, reporting, and safety training will be the responsibility of the Owner.

2.13 CO2 TANK BCO-T1

- A. A. The 30-Ton vertical CO2 storage vessel will be vacuum jacketed with a stainless steel inner vessel and dent resistant steel alloy outer vessel. The vacuum jacketed insulation does not require refrigeration. A 30 kW multifunction vaporizer with pressure build and gas heater will supply CO2 gas to the feed panel. An electrical control panel will be provided and will comply with NEC Codes. Tank height is 32 feet. A. The system will require 480V, 3-ph, 60-Hz, 80 Amp power feed to the BURNETT CO2 power panel.

2.14 CO2 FEED PANEL BCO-FP1

- A. Enclosure: NEMA 4X panel enclosure.
- B. Components:
 - 1. The filter will be designed for industrial and commercial filtration needs. The filter will be constructed of 304L SS with 1" FNPT connection and T-handle/Buna gasket using a simple bolt-n-nut design for quick cartridge change-outs.
 - 2. Pressure regulators will be self-operated pressure reducing regulators equipped with a pilot tube for greater regulated capacities. The pressure regulators will reduce pressure in approximately 50% increments to the desired operating pressure of approximately 75 PSIG.
 - 3. A pressure transmitter will be included on the feed line to detect a pressure regulator failure and would signal an alarm.
 - 4. There will be a gas mass flow controller on the feed line, which provides isolated 4-20 mA inputs for flow rate and process gas temperature to the CO2 system PLC, as well as a 4-20 mA setpoint for control.
 - 5. A manual needle flow control valve with a viewable flow via rotometer will be available on the feed line in case manual control is needed.
 - 6. A solenoid valve on the feed line will be NEMA 4 rated, 2-way, internally piloted, and normally closed.
 - 7. Electrical conduit and CO2 pipe (304 SS 1/2" or 3/4") between the CO2 pressure tank and the CO2 feed panel is supplied by the Owner/General Contractor.

8. Electrical conduit from the power panel of the CO2 storage tank to the CO2 feed panel provided and installed by the Owner/General Contractor.
9. The CO2 pipe (304 SS 1/2" or 3/4") is provided, installed, and pressure tested by the Owner/General Contractor from the CO2 storage tank to the CO2 feed panel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All installation shall be in strict compliance with the manufacturer's written instructions. All anchor bolts placed in the concrete structure will be located, drilled, and installed in place with epoxy according to the manufacturer, as approved by the Engineer. All electrical connections will be made in accordance with the National Electric Code (NEC).

3.02 MANUFACTURER'S SERVICE

- A. Furnish the services of a factory representative for one, eight-hour day during the installation phase of the equipment. The factory representative will have full knowledge and experience in the installation of the type of equipment being installed.
- B. Furnish the services of a factory representative, having complete knowledge of proper operation start-up procedure and maintenance requirements, for one, eight hour day, to inspect the final installation, supervise a test run of the equipment, and instruct the Owner's personnel in the proper operation of the system.

3.03 MANUFACTURER'S SYSTEM WARRANTY

- A. The manufacturer will warrant that all supported materials and components will function as specified and be free from defects in manufacturing, design, and fabrication for a period of one year after the system is placed in operation or two years from the date of installation, whichever comes first. Equipment components and accessories manufactured by others but purchased through Burnett Lime Company, Inc., such as electric motors, valves, and other controls, are guaranteed only to the extent of coverage offered by their original manufacturer. Expressly excluded from the warranty are defects caused by misuse, abuse, or improper applications, employment, or operation of the unit. The warranty does not cover acts of God, such as lightning, explosion, fire, flood, or terrorist acts. This warranty does not extend to damage caused by day-to-day operation considered normal wear items, such as tubes, seats, diaphragm, etc. Equipment, such as tank, mixer, pumps, and associated electrical equipment, is covered under this warranty, and if the equipment requires repair or replacement as a result of ordinary wear and tear under normal conditions, Burnett Lime Company, Inc. will repair or replace such equipment as required without cost to the Owner. Alterations or changes to the Burnett Lime Company, Inc. CAL~FLO® Lime Slurry System and/or slurry without approval from Burnett Lime could void the warranty.

3.04 THE SLURRY:

- A. The delivered slurry concentration will be 30% and the system will feed an established dilution of the delivered concentrate. Strict quality control from the manufacturer is important to the smooth operation of the CAL~FLO® system. Consequently, carbide limes and generic slurries may have coarse inert particles that could interrupt chemical feeding.

3.05 CLEANING

- A. Owner/General Contractor will clean area of all debris prior to testing and start-up and will provide a clean, clutter-free, and safe working environment for Burnett Personnel.
- B. Burnett will clean and remove from the site all excess construction materials brought on-site by Burnett utilized in the installation and start-up of the CAL~FLO® Lime Slurry Feed System.

3.06 STARTUP

- A. Burnett will conduct a site acceptance test upon the completion of the installation. Tests will be conducted using water as the testing media. Owner / General Contractor shall be responsible for the providing and disposal of the water, and the providing of the power from either the permanent or temporary source.

3.07 WORK BY OTHERS

- A. Foundations, floor slabs, grading, grating, and electrical conduit in slab.
- B. Grounding for the building and tank.
- C. All drainage from floor drains.
- D. Curbs and containment structures.
- E. All trenching, feed line conduit, open trenching, wall sleeves coring, and tapping.
- F. 480/3ph/60Hz, 60 AMP power to and terminating in the control panel.
- G. All communication cable/wiring from the plant SCADA to the Lime System PLC.
- H. Usually this is Ethernet wiring or fiber optic cable.
- I. 2-inch valve service water connection (minimum 50 GPM) including backflow prevention (if required) and customer service connection within the building building. Service water pressure not to exceed 70 pounds to the CAL~FLO® system.
- J. Final painting of the exterior of the tank dome, sidewall, and appurtenances.
- K. Perform the final cleaning of the area.
- L. All signage, including safety and chemical placards as required.

3.08 BURNETT CO2 FEED SYSTEM CONTROL

- A. This system will be controlled by the Allen-Bradley CompactLogix® L33ER PLC located in the Lime System Control Panel. Monitoring of the pressure, valves, level, and controls will be presented via Ethernet from the Lime / CO2 PLC system to the Owner's SCADA system.
- B. The signal connection between the system PLC and plant SCADA/HMI will be by the Owner/General Contractor. The flowpacing setpoint signal in lbs/hr for the Burnett CO2 System is supplied from plant supervisory system based on flow rates, desired pH, etc.

3.09 FEED LINES

- A. Feed lines provided by the General Contractor will be 1/2" or 3/4" approved gas lines from the CO2 feed panel to the flange mount for the diffuser injection. CO2 diffuser for the feed point will be provided by Burnett.
- B. Owner/General Contractor is to provide and install the feed line underground from the CO2 feed panel to the feed point. Pressure testing to 100 PSI minimum of the CO2 feed line is required to match the engineer approved CO2 gas line.

3.10 CLEANING

- A. General Contractor will clean the area of all debris prior to testing and start-up and will provide a clean, clutter-free, and safe working environment for Burnett personnel.
- B. Burnett will clean and remove from the site all excess construction material brought on-site by Burnett utilized in the installation and start-up of the CO2 System.

3.11 STARTUP

- A. Burnett will conduct a site acceptance test upon the completion of the installation.
- B. Owner/General Contractor shall be responsible for providing the power from either the permanent or temporary source.

3.12 WORK BY OWNER/GENERAL CONTRACTOR

- A. Foundations, grating, and electrical conduit to site.
- B. Grounding for the tank and control panel.
- C. Curbs and containment structures.
- D. Power supply to the CO2 tank and terminating in the power distribution panel.
- E. Electrical conduit between the CO2 storage tank and the PLC panel.
- F. Signal connection between the system PLC and plant SCADA/HMI.
- G. Trenching, open trenching, wall sleeves coring, and flange mount for each diffuser assembly.
- H. 1/2" or 3/4" approved stainless steel pipe pressure tested to 300 PSI between CO2 tank and CO2 feed panel.
- I. 1/2" or 3/4" approved gas line between CO2 feed panel and feed point. Required pressure testing (minimum of 100 PSI) to match engineer CO2 approved gas line.
- J. Anchoring of the CO2 system.
- K. CO2 Feed System to be located in close proximity to the Lime Feed System for shared PLC panel.

END OF SECTION

SECTION 46 33 00

METERING PUMPS, SKIDS & TANKS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. metering pump systems shall be a complete turnkey system inclusive of all necessary fluid handling and ancillary components to ensure the reliable metering of chemical into a treatment process.
- B. The key components of this system are as follows:
 - 1. Metering Pumps
 - 2. Calibration Column
 - 3. Pressure Relief Valve
 - 4. Discharge Pressure Gauge with Diaphragm Seal
 - 5. Fabricated HDPE Shelf with pre-piped Back Panel in one of following configurations, simplex, duplex-duty/standby, duplex-dual discharge or triplex.

1.02 QUALITY ASSURANCE

- A. Chemical Metering System (skid) shall be manufactured by the chemical metering pump manufacturer and shall provide pumps and accessories as a complete turnkey system. Skids manufactured by third parties such as separate skid fabricators, pump distributors or pump representatives are not acceptable.
- B. This specification is the basis for design of peristaltic metering pumps. All pumps, whether named as an acceptable supplier or submitted as an equal shall, at a minimum, meet the following critical design requirements.
 - 1. Pump shall be 24 hr continuous duty rated and have a three-year manufacturer's warranty from date of shipment.
 - 2. For quality assurance, pumps shall be supplied and labeled by the original manufacturer. Relabeled products, even under license by manufacturer, shall not be acceptable.
 - 3. Pumps shall be manufactured in compliance with ISO 9001-2015 standards.
 - 4. Pumps shall meet CE, NSF 61 and applicable electrical standards.
 - 5. To ensure proper function and quality, pumphead, tubing, and drive shall be manufactured by the same company.
- C. Chemical tanks shall be provided by the manufacturer and coordinated with chemical metering pump skids by Contractor. Tanks shall be oriented, anchored, and connected so as to provide a complete chemical injection system.

1.03 SUBMITTALS

A. Submit the following:

1. Certified shop drawings.
2. Characteristic performance curve showing flow rate as a function of RPM and pressure.
3. Chemical Metering System Arrangement & Installation drawings.
4. Operating, maintenance, programming, and wiring instructions for all equipment
5. Tool-free pumphead replacement instructions
6. Manufacturer's certification that pumphead, drive, and tubing are all manufactured by the same manufacturer.

1.04 DELIVERY, STORAGE, & HANDLING

A. Shipping

1. Ship the Chemical Metering System completely assembled and ready for installation. Ship tubing separately for field installation and process line connection by contractor.
2. Pack all additional spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
3. Deliver spare parts at the same time as pertaining equipment. Deliver to Owner after completion of work.

B. Receiving

1. Contractor to inspect and inventory items upon delivery to site.
2. Contractor to store and safeguard equipment, material, instructions, and spare parts in accordance with manufacturer's written instructions.

1.05 MANUFACTURERS

- A. Chemical Metering Pumps: Grundfos DDA, Watson-Marlow QDOS. or approved equal
- B. Polymer Pump Systems: Polymer Blending System, UGS Polyblend PB Series or equal.
- C. Chlorine Dioxide Systems: Evoqua Water Technologies LLC., or approved equal.
- D. Bulk Chemical Tanks: Snyder Industries, Assman Corporation, or approved equal.

PART 2 - PRODUCTS

2.01 CHEMICAL METERING SKID SYSTEM COMPONENTS

A. Peristaltic Chemical Metering Pump

1. Pumps shall be positive displacement type complete with replaceable cartridge-style peristaltic pumphead technology and self-contained variable speed drive as specified.
2. Pumps shall be self-priming and shall have a maximum suction lift capability of up to 30-feet vertical water column.
3. Discharge Pressure Rating: 30 psi, minimum
4. Pumps shall be capable of pumping both liquids and gases without vapor locking.
5. Pump shall not require the use of back pressure valves, suction foot valves, strainers, pulsation dampeners, or auto degassing valves and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components during operation. Upon failure, the process fluid shall be completely contained within the pump head to prevent hazardous exposure to operators. Manufacturer's that do not offer a completely contained pump head are not acceptable.
6. Pump Process Schedule

Chemical Metering System Configuration	Pump Capacity	Number of Pumps
Flow Range Min– Max (GPH)	1) Sodium Hypochlorite 4 GPH – 12 GPH 2) Alum 5 GPH – 25 GPH 3) Sodium Per Manganate – 1 GPH – 3 GPH 4) Fluoride – 1 GPH – 3 GPH 5) Phosphate - 1 GPH – 3 GPH 6) Chlorine Dioxide – 1 GPH – 3 GPH 7) Polymer – 7 GPH – 15 GPH	1) Sodium Hypochlorite Triplex 2) Alum Duplex 3) Sodium Per Manganate Duplex 4) Fluoride Duplex 5) Corrosion Control Duplex 6) Chlorine Dioxide pumps: by manufacturer 7) Polymer pumps: by manufacturer
Average Flow (GPH)	1) Sodium Hypochlorite – 6 GPH 2) Alum 10 GPH 3) Sodium Per Manganate – 2 GPH 4) Fluoride 2 GPH 5) Phosphate 2 GPH 6) Chlorine Dioxide 2 GPH 7) Polymer 10 GPH	
Average Discharge Pressure (PSI)	5 psi	
Maximum Discharge Pressure (PSI)	15 psi	
Suction Head	36"	

7. Pump Construction

a. a. Pumphead

- 1) Technology: Provide tool-free cartridge-style peristaltic pumphead technology. For operator safety, pumphead shall be serviceable as a single replaceable component. Pumps that require an operator to open the pumphead for tube replacement, cleaning, or rebuilding or that require tools for maintenance are unacceptable.
- 2) Housing construction: corrosion resistant and high impact resistant glass filled PPS or PPE/PS.
- 3) Geometry: Pumphead shall consist of sealed track housing with in- line porting. Suction and discharge ports shall be 180 degrees apart with bottom suction and top discharge.
- 4) Rotor: Pumphead rotor shall be constructed of glass filled Nylon, sealed within the track housing, and supported by its own bearings. Peristaltic occlusion level shall be factory set to ensure flow accuracy of +/- 1% and repeatability performance of +/- 0.5% and shall not require any field adjustment.
- 5) Contact Materials: All pumphead components in the fluid path shall be NSF61 listed and shall be of materials specified by the manufacturer as compatible with the process fluid.
- 6) Leak containment/detection: In the event of peristaltic element failure, the leak sensor shall shut the pump down immediately with all process fluid contained within the sealed pumphead.
 - a) Sensor type: Utilize non-contacting optical sensor. Sensor shall not come in contact with the process fluid, shall contain no moving parts, shall not depend on the capacitance of the process fluid, shall not require fluid to leak out of the pump housing for engagement, nor shall require any sensitivity or calibration adjustment.
 - b) Alarm: Sensor shall shut down the pump, give a visual indication on the drive controller, and if specified shall provide an output general alarm signal.
 - c) For operator and environmental safety, pumps which do not have leak containment, leak sensor, and shutdown are not acceptable. For additional overpressure safety, sealed pumphead shall have a controlled drain-to-waste port.
- 7) Port connections: Pumphead shall utilize PVDF compression fittings which shall mate to ¼" x 3/8" or 3/8" x ½" PE interface tubing. Provide polypropylene compression by ½" NPT adaptors for connecting interface tubing to process line.
- 8) Spares: Provide one (1) spare pumphead per pump supplied.
 - a) Drive
 1. Rating: Continuous 24-hour operation, 45o C ambient.

2. Voltage: Drive shall be suitable for 100-240VAC, 50-60Hz,

- 9) Phase with an internal switch-mode power supply. Supply nine- foot length mains power cord with standard 115VAC three-prong plug.
- 10) Max drive power consumption: 190VA.
- 11) Enclosure: NEMA 4X constructed out of corrosion and impact resistant engineering plastic, 20% Glass filled PPE/PS. By nature of the environmental conditions, painted or unpainted metallic housing including 316SS are not acceptable. Enclosure shall house the drive motor and all control circuitry in one integrated unit. Separate VFDs and motors are not acceptable.
- 12) Direct coupled pumphead with fully protected drive
 - a) Pumphead shall direct couple mount to the controller via a splined drive shaft and shall be locked in place by two tool-free thumbscrews or lever mechanism.
 - b) Pumphead shall be fully sealed to prevent any contamination of the controller or drive shaft by process fluid.
 - c) Pumphead shall contain its own rotor bearings and not impart an overhung load on the pump shaft.
 - d) Pumpheads shall be supplied mounted to the left or right side of the drive enclosure as specified in the drawings.
 - e) Drive shall stop shaft rotation and give visual alarm in the event the pumphead is removed.
- 13) Drive motor: brushless DC motor with integral gearbox and closed loop tachometer feedback.
 - a) Circuitry complete with temperature and load compensation and protection.
 - b) Human-Machine Interface (HMI) and Control For both Analog Remote Control and Manual Control capability

1. Manual Control Interface

- i. Display: Backlit graphical TFT Display capable of up to 8 lines of text with up to 26 characters per line to display pump tag number, flow rate, and programming instructions. Display shall also provide visual indication of running status via screen color: Blue = Running, White = Stopped and Red = Warning.
- ii. Keypad: Keypad for start, stop, speed increment, speed decrement, rapid prime, and programming.
- iii. Flow units: Programmable in either ml/min or gallons/hour.
- iv. Security: Programmable keypad lock and PIN security for optional lockout of all keys except emergency start/stop.

- v. Auto Restart: feature to resume pump status in the event of power outage interruption.
- vi. Fluid level monitor: Programmable flow totalization to advise operator when their supply tank is low.

2. Remote Control I/O

- i. Speed Control Input: Analog 4-20mA speed input with 1,600:1 turndown with incremental steps of 10 microamps. Signal shall be trimmable and speed scaleable over any part of the drive speed range. Pump shall be programmable to either increase pump speed or decrease pump speed against an increasing Analog 4-20 mA signal.
- ii. Run/Stop Input: Either 5-24V industrial logic, dry contact or powered 110 VAC contacts as shown per the process and instrumentation drawings.
- iii. Run/Stop & General Alarm Status Outputs: Either 24VDC Open Collector, 24VDC Status relay, or 110VAC Status Relay
- iv. Status Outputs: Four status outputs, 24VDC Status relay, or 110VAC Status Relay as required by the process and instrumentation drawings software configurable to indicate the following:
 - 1. General Alarm status
 - 2. Running/Stopped status
 - 3. Manual Mode status
 - 4. Analog Mode status
 - 5. Contact Mode status
 - 6. Fluid Level status
 - 7. Leak Detected status

B. Calibration Columns

- 1. Supply Calibration Column made of clear PVC or Acrylic cylinder materials, sealed on both ends with appropriately sized NPT threaded ports both top and bottom. Graduation markings shall be in fractions of gallons or milliliters in proportion to the size of the column.
- 2. Column shall be sized to allow a minimum 30-second draw down at maximum pump speed.

C. Pressure Relief Valve

- 1. Supply Pressure Relief Valve with PVC Body and PTFE/EPDM Diaphragm.
- 2. Relief Pressure shall be adjustable from 10-150 psi.
- 3. Connections shall be designed with unions and socket welded.

D. Discharge Gauge with Diaphragm Seal

1. Discharge Pressure Gauge shall have a 2.5-inch dial with a liquid filled case, stainless steel tube and socket with a pressure range of 0-160 psig
2. Discharge Gauge shall be assembled to a Diaphragm Seal with a Teflon Diaphragm and 1/2-inch NPT PVC process connection.

E. Fabricated HDPE Shelf with Back Panel

1. HDPE Shelf with Back Panel shall be fabricated out of 1/2-inch and 3/4-inch sheet stock. The Shelf and Back Panel shall be fusion welded together maintaining a 1-inch containment lip completely around the surface in which the pump sits. Metallic Shelves & Back Panels including those that are painted or coated are not acceptable.
2. All necessary piping to incorporate the above equipment into a single turnkey chemical metering system shall be secured to the Shelf and Back Panel.
3. HDPE Shelf & Back Panel shall be designed to be either free standing with fork lift slots or wall mounted. (*(Engineer to specify)*)
4. Mounting Hardware & Installation shall be supplied by the Contractor

F. Isolation Valves

1. All Ball Valves, sizes 1/2-inch to 4-inch, shall be of true union design with two-way blocking capability. All O-rings shall be EPDM or FPM based on chemical being pumped. Seats shall have elastomeric backing cushion of the same material as the valve seals. Stem shall have double O-rings and be of blowout-proof design. The SCH 80 PVC & CPVC ball valves shall have a pressure rating of 250 psi for sizes 1/2-inch to 2-inch and 235 psi for 2-1/2-inch to 4-inch at 70 degrees F. Ball Valves shall carry a two-year guarantee. Ball valves shall be equal to Hayward TB series as manufactured by Hayward Flow Control

G. Piping

1. Polyvinylchloride (PVC) Pipe and fittings shall be manufactured of Rigid Poly Vinyl Chloride (PVC) schedule 80. Fittings shall be heavy-duty Schedule 80

2.02 POLYMER METERING SKID SYSTEM COMPONENTS

A. Polymer Blending System, including:

1. 400-gph Manual Control Blender
2. 10-gph manual Control Metering Pump
3. Chemical Drum Mounted Mixer and Dessicant Breather
4. 3/4" drum suction wand with inlet screen
5. Stainless Steel Stand

2.03 CHLORINE DIOXIDE GENERATION SYSTEM:

- A. This section includes the fabrication, delivery, installation, and placement into successful operation of a chlorine dioxide generator sized to make maximum 20 pounds per day of chlorine dioxide from precursors. All materials shall be provided in accordance with these specifications.
- B. All components of the system shall be compatible with the conditions and chemicals to which they are subjected to during the normal operation of the system. Precursors for Chlorine Dioxide include:
1. Sodium Chlorite (25% Active)
 2. Sodium Hypochlorite (12.5% Active)
 3. Hydrochloric Acid (15% Active)
 4. The system shall be provided by Evoqua Water Technologies LLC., or approved equal.
- C. Project Description:
1. All equipment shall be furnished by a single manufacturer who shall be responsible for the coordination of the system design.
 2. The Chlorine Dioxide generator shall be constructed and certified in compliance with and according to NSF-61 Section 8. Changes affecting NSF-61 certification shall not be allowed.
 3. Chlorine dioxide shall be produced by reacting chlorine gas produced in-situ under vacuum by the reaction of sodium hypochlorite and hydrochloric acid with a solution of sodium chlorite. A 25 percent sodium chlorite solution (by weight) shall be used. The reaction shall be assisted with a water operated ejector included with the generation equipment. Chlorine dioxide shall result from the complete reaction of the chemicals in the generator's reaction column prior to dilution and eduction into the motive water stream. As produced the chlorine dioxide is ejected via vacuum and immediately dissolved in the motive stream of water that drives the generator's vacuum eductor.
 4. The reaction shall be controlled by the metering of the three reactants with water as follows:
 - a. Sodium chlorite is precisely utilized with a magmeter, rotameter and an auto metering flow control valve fed to a reaction chamber.
 - b. Sodium Hypochlorite is precisely utilized with a magmeter, rotameter and an auto metering flow control valve fed to a reaction chamber.
 - c. Hydrochloric acid is precisely utilized with a magmeter, rotameter and an auto metering flow control valve fed to a reaction chamber.
 5. The chlorine dioxide gas in an ejector water stream for onward dose delivery to the injection point at variably adjustable concentrations between 200 and 2,000 mg/l
- D. Manual Feed Control
1. Chlorine dioxide solution concentration shall be generated to a precision within +/- 3% The feed rate (example ppd, pphr) of chlorine dioxide shall be based on the included manufacturer's rotameter settings feed rate chart Rotameter reagent feed rate settings on the rotameter tubes shall be scaled from 10% to 100% in 10% increments.

- E. The manufacturer shall submit complete shop drawings and engineering data to the Engineer. These submittals shall include, at a minimum:
1. Drawings showing plan and elevation views of the generator feed system
 2. Relay control system layout drawing
 3. Relay control system electrical diagram
 4. Manufacturer catalogue information on major system components.
 5. Design conditions
- F. Operation and maintenance manual shall be provided by the Manufacturer prior to or at time of installation of all major equipment components.
- G. Delivery shall be coordinated with the Contractor.
- H. Product Information:
1. The feed system shall be capable of producing 20 pounds maximum per day of chlorine dioxide with a minimum 10:1 turn-down capability based on manual reagent feed rotameter settings.
 2. The pH of the produced aqueous chlorine dioxide product stream exiting the generator shall be greater than 4.5 and less than 6.0, and this pH range shall be accomplished without addition of an acid or alkali to the motive water stream used to drive the generator's vacuum eductor.
- I. General:
1. All components comprising the chlorine dioxide generation system shall be mounted on a 316 stainless steel frame. The skid frame shall be constructed with mounting tabs such that anchors can affix the skid to a concrete masonry wall.
 2. All material in contact with chlorine dioxide shall be constructed of FRP, glass, PVC or non-corrosive metal. All piping materials and valves exposed to chlorine and /or chlorine dioxide gas or liquid, and sodium chlorite solution shall be constructed of schedule 80 PVC, PVDF, or Teflon. Piping shall be furnished with sufficient unions to permit assembly and disassembly. All shutoff valves shall be true union ball valves.
- J. Electrical:
1. Electrical apparatus on all equipment shall be installed complete and placed in readiness for proper operation.
 2. Separate enclosures shall be provided for power supply and control components.
 3. Electrical materials furnished and installed 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.

4. Electrical conduit shall be flexible PVC per equipment manufacturer standard design, or otherwise as mutually agreed between contractor, owner and equipment manufacturer in advance of equipment manufacture and installation.
5. Electrical power cables to be Junior Severe Service Oil and Weather SJOW resistant, Machine Tool Wire (MTW) or Thermoplastic Heat and Water Resistant Nylon (THWN). Instrumentation cable to be standard shielded twisted pair.

K. Control System:

1. A Relay Control Panel shall be provided with the generator by the generator manufacturer and shall be capable of local and remote generator start-stop capabilities (allowing for local and remote operation of the system).
2. The chlorine dioxide system shall have a failsafe design. Precursor feed shall be safely stopped on loss of system power or motive water process water flow.
3. The chlorine dioxide system shall have a water flush system to safely clear precursors from the reaction chamber.

L. Instrumentation and Piping Components:

1. A rotameter shall be used for sodium chlorite control and feed to the generator's reaction column and shall be capable of precise flow measurement in the range appropriate to the generator size. Similar W&T S-10K rotameters shall be used for sodium hypochlorite and hydrochloric acid feeds to the generator's reaction column.
2. A motive water rotameter shall be used to monitor motive water flowrate to the generator's vacuum eductor
3. A shutoff valve shall be provided on the motive / process water inlet to the generator. The isolation valve shall be fail in a closed position if power is removed from the system.
4. Precursor rotameters shall be capable of precise flow rate control in the range appropriate to the generator size, and shall be set manually by operator using feed rate chart provided by the generator manufacturer.
5. A pressure control valve shall be located on the motive / process water inlet line to regulate pressure supplied to the generator's eductor
6. Check valves shall be placed in the system to prevent backflow condition to all precursor feed points including process water
7. Precursor isolation valves (check valves) shall be actuated by the supply of motive – process water such that the valves shall fail in the closed position if the supply of motive process water and/or vacuum is lost.
8. A sight tube of clear PVC shall be provided on the eductor outlet to provide a view of chlorine dioxide solution color.
9. True Union Ball valves shall be used throughout the skid design.
10. Pressure gauges shall be located before and after the water eductor to evaluate eductor differential pressure.

M. Motive Water Feed (Booster) Pump:

1. A vertical multistage centrifugal pump shall be utilized to transport a maximum of 8 gpm of potable or filtered process feed water from a minimum inlet pressure of 25 psi to 120 psi. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. All pump bearings shall be lubricated by the pumped liquid. Pump shall be constructed as per the table below:

Suction/discharge base, pump head	Cast Stainless Steel (ASTM CF-8M)
Motor stool, base plate	Cast iron (ASTM Class 30)
Flange Rings	Ductile Iron (ASTM 65-45-12)
Shaft	316 or 329 Stainless Steel
Impellers, diffuser chambers, outer sleeve:	316 Stainless Steel
Impeller wear rings	316 Stainless Steel
Shaft journals and chamber bearings	Silicon Carbide
Collar, Drivers, Spring:	316 Stainless Steel
Shaft Sleeve, Gland Plate:	316 Stainless Steel
Stationary Ring:	Silicon Carbide
Rotating Ring:	Silicon Carbide
O-rings:	EPDM

N. Booster Pump Motor:

1. Booster pump motor shall be designed for continuous duty operation, NEMA design B with a 1.15 S.F. with class "F" insulation. Motor nameplate shall be mounted on enclosure with stainless steel fastening pins. Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the lowest allowable continuous flow rate for the pump.

O. Shop Testing:

1. The Manufacturer shall perform shop tests at its factory. These tests shall include at a minimum:
 - a. Visual inspection of all equipment. Complete assembly, start-up, and hydrotest of generation skid operation.
 - b. Written verification of test procedure by a project manager documenting that all major and minor components function as intended including failsafe functions and controls.

P. Start up and Training:

1. The manufacturer of the chlorine dioxide generator chemical feed system shall furnish a factory-trained representative for 2 days for the feed systems supplied to start up the system and train operating personnel. One additional half day training for lab and operator personnel shall be included.

Q. Warranty:

1. The Manufacturer shall guarantee that the chlorine dioxide generator system will perform as described in these Specifications provided that precursor raw materials meet manufacturer's recommended specifications. The Manufacturer shall warrant the system, complete, to be free from defects in materials or workmanship for a period twelve (12) months from install, start-up and acceptance. The Manufacturer shall repair or provide replacement for any defective components under this warranty.

2.04 BULK CHEMICAL STORAGE TANKS:

- A. The bulk chemical storage tanks shall be of the volume noted on the plans, with approximate size as shown. Tanks shall be opaque FRP or HDXLPE with outside level indication on the tank. The minimum required wall thickness of the cylindrical shell at any fluid shell be determined by the following equation but shall not be less than 0.187" thick.

1. $T = P \times O.D./2 SD = 0.433 \times S.G. \times H \times O.D./2 SD$
2. $T =$ wall thickness
3. $SD =$ hydrostatic design stress, PSI
4. $P =$ pressure (.433 x S.G. x H), PSI
5. $H =$ fluid head, feet
6. $S.G. =$ specific gravity, g/cm³
7. $O.D. =$ outside diameter, inches

- B. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples with a service factor selected for the application. The hydrostatic design stress is 600 PSI at 73° F for Type 1 and Type II materials. The tank shall have a stratiform (tapered wall thickness) wall.
- C. The hydrostatic design stress shall be derated for service above 100° F and for mechanical loading of the tank. The standard design specific gravity for the alum tank shall be 1.5.
- D. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Flat areas shall be provided to allow locating large fittings on the cylinder straight shell.
- E. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The top head of the tank shall be designed to provide a minimum of 1,300 square inches of flat area for fitting locations.
- F. The tank shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of an empty tank.

- G. The tank shall be designed to provide a minimum of 4 tie-down lugs integrally molded into the top head and to allow tank retention in wind and seismic loading situations without tank damage.
- H. The tank shall be heat traced as follows. Heating systems for use with polyethylene tanks shall be designed to meet specific requirements such as tank material type, tank size, low ambient temperature and desired maintenance temperature. All heating system components shall be NEMA 4 rated and factory pre-wired for 110 or 220 VAC. Each control box shall contain two temperature controls. One control shall regulate the maintenance temperature setting, and the other control shall regulate the high temperature setting. The maintenance temperature setting should be set at the desired maintenance temperature. The high temperature setting shall be adjusted to 10° above the desired maintenance temperature to a maximum of 130° F. All control systems must be designed with a power off failure mode. The heating panels shall be designed to wrap around and lie flat against the surface of the tanks. The heating panels shall have a maximum heating density of 0.022 watts per square centimeter. All heating panels and sensor bulbs shall be attached to the tank with 2" wide duct tape. Under no circumstances shall cable type heaters be used with polyethylene tanks. Insulation used shall be polyurethane foam with a density of 2.0 – 3.0 pound/ft3 with an "R" value of 8.33/in. The foam shall be applied with a nominal thickness of 2" to all external tank surfaces except the tank bottom shell. Upon completion of application and curing of the insulation, two full coverage coats of latex mastic coating shall be applied to the surface of the insulation in such manner as to seal the insulation from the outside environment.
1. Size: Tanks shall be vertical, flat bottom, dish top, of following nominal capacities:
 - a. Alum - 10,000 gallons (note – 2 Alum tanks must be provided)
 - b. Sodium Hypochlorite – 10,000 gallons
 - c. Sodium Chlorite – 2,500 gallons
 - d. Hydrochloric Acid – 2,000 gallons
 - e. Sodium Permanganate – 2,000 gallons
 2. Quality Assurance: Acceptable manufacturer shall be Snyder Industries, Inc., Assmann Corporation, or equal.
 - a. Tanks shall meet all appropriate standards for polyethylene tanks and piping as described by ASTM, ARM and ANSI.
 - b. Chemical compatibility shall be according to the following chemical resistance guide: Pruett, Kenneth M., "Chemical Resistance Guide for Elastomers", Compass Publications.
 3. Loading Calculations: Tank shall meet the following design criteria:
 - a. a. Wind load limit when anchored: 100 mph
 - b. b. Concentrated top load limit: 1,000 pounds at 10 psi
 - c. c. Snow load-limit: 25 psf
 4. Chemical Storage Requirements:

- a. Alum 50% Solution: Maintain 45 degrees F at ambient temperature of 0 F and 1.3 specific gravity. Tank shall also be suitable for storage of ferric chloride solution (38% solution and 1.42 specific gravity) aluminum chloride solution (28% solution and 1.3 specific gravity)
 - b. Sodium Hypochlorite 12.5% Solution: Maintain 45 degrees F at ambient temperature of 0 F and 1.2 specific gravity.
 - c. Sodium Chlorite: 25% solution: Maintain 45 degrees F at ambient temperature of 0 F and 1.2 specific gravity.
 - d. Hydrochloric Acid 15% solution: No heat tracing required.
 - e. Sodium Permanganate 20% solution: Maintain 45 degrees F at ambient temperature of 0 F and 1.2 specific gravity.
5. Accessories:
- a. Flanged Nozzles: Conically gusseted, flanged diameter and drilling, ANSI B6.5, 150 pounds, 40-50 durameter $\frac{1}{8}$ " thickness full-faced gaskets
 - b. Tie Down Lugs: Number and location standard with manufacturer
 - c. Tank Lifting Lugs: Provide 3 lifting lugs spaced 120° apart at top portion of straight shell with one aligned with a hold down lug
 - d. Certification label stating:
 - 1) Resin Used
 - 2) Serial Number
 - 3) Chemical to be stored including concentration and specific gravity
 - 4) Tank capacity
 - 5) Date of manufacture
6. Level Indicator: Level control shall be as specified.
7. Panel enclosure shall be a polycarbonate enclosure rated NEMA 4X and shall be located perpendicular to the control panel.
8. Thermometer and Thermowell: Bi-metal 3" dial thermometer, range -40°F to 160° F, both case and $\frac{1}{2}$ " NPT connection, thermowell (separable socket) for 4- $\frac{1}{2}$ " insertion length with $\frac{3}{4}$ " male thread. Thermowell wetted parts and connectors shall be made of applicable corrosion resistant material, Hastelloy C-276, or equal. Thermowells shall be corrosion resistant for each of the following chemicals: alum, caustic and ferric chloride. Thermowell to be similar to those as manufactured by Trerice or equal.
9. Schedule (Contractor to coordinate location of fittings):
- a. 1 – 24" top hinged manway with cover or manufacturer's standard cover with air surge device

- b. 1 – 2" flanged nozzle for liquid level float
- c. 1 – 2" flanged nozzle, inlet, outlet and drain
- d. 1 – ¾" FPR threaded coupling for thermometer and thermal well
- e. 1 – 24" top hinged manway with cover
- f. 1 – Carbon steel ladder
- g. 1 – 3" Overflow outlet at top of shell portion of tank

PART 3 - EXECUTION

3.01 GENERAL

- A. Contractor to coordinate as required with other trades to assure proper and adequate provision of the work as required for a proper and professional installation.
- B. Contractor shall install items in accordance with manufacturer's printed instructions and as indicated and specified.
- C. Contractor to connect suction, discharge, vent and drain connections as required.
- D. Contractor shall supply shielded signal wiring for wiring of the required remote input and output to the connectors.
- E. All exposed chemical and tank piping shall be heat traced and insulated
- F. Chemical systems shall operate as a system, with all components working in coordination to provide the required performance.

3.02 METERING PUMPS AND SKIDS

- A. Hydrostatic Test: After pumps have been installed and before placing in service, operate at service pressures and check for leakage.

3.03 CHEMICAL STORAGE TANKS

- A. Hydrostatic Test: After tank has been installed and before piping connections are made and equipment attached, block outlets and fill straight shell portion with water and check for leakage.

END OF SECTION

SECTION 46 41 11

VERTICAL SHAFT TURBINE RAPID MIXER

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install ready for use, one (1) heavy duty vertical shaft turbine rapid mixer including all necessary appurtenances for the complete assembly as indicated on the Plans and as specified herein.
- B. The mixer shall be complete assembly including but not limited to the gear reducer, motor, shafting, impeller, coupling, pedestal mounting base and other appurtenant equipment necessary to be complete and operable in accordance with the requirements of the contract documents.

1.02 REFERENCED STANDARDS

- A. AFBMA - Anti-Friction Bearing Manufacturers Association
- B. AGMA - American Gear Manufacturers Association
 - 1. AGMA 390.03 - Gear Handbook Volume 1: Gear Classification, Materials and Measuring Methods for Unassembled Gears.
 - 2. AGMA 299.01 - Sound Manual.
 - 3. AGMA 6010.E88 - Spur, Helical, Herringbone and Bevel Enclosed Drives.
- C. ANSI - American National Standards Institute
- D. ASTM - American Society for Testing and Materials
- E. NEMA - National Electrical Manufacturers Association
- F. OSHA - Occupational Safety and Health Administration, Code of Federal Regulations, (CFR 29)

1.03 QUALITY ASSURANCE

- A. Each mixer shall be completely shop assembled and factory tested to assure proper fit-up, and acceptable limits of vibration, shaft run out and motor power draw. The equipment shall then be packaged for shipment and jobsite storage to prevent damage or corrosion.
- B. The equipment seller shall be solely and fully responsible for warranty and mechanical design adequacy of all the provided under this section of the specification.

1.04 SUBMITTALS

- A. Copies of all materials to establish compliance with the specifications shall be submitted in accordance with the provisions as outlined. Submittals shall include at least the following:

1. Complete description of all materials.
2. Drawings showing complete dimensional data of the proposed mixer design including the mixer outline dimensions, mixer drive, output coupling, and impeller assembly data and mounting details.
3. A complete bill of materials
4. The weight of the complete mixer assembly and each component; motor, gearbox, shafting and impellers.
5. Description of surface preparation, shop priming and finish painting of the mixer.
6. Mixer design calculations and process design calculations.
7. Complete motor data.
8. Mixer installation, operation and maintenance information

1.05 OPERATION AND MAINTENANCE DATA

- A. Operating and maintenance instructions shall be furnished per the instructions included in the specification. The instructions shall be prepared specifically for this installation and shall include start-up data, trouble shooting guides, routine maintenance procedures, lubrication data, drawings, equipment lists, descriptions, etc. that are required to instruct operating personnel.

1.06 DELIVERY, STORAGE AND HANDLING

- A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as to not to degrade quality, serviceability or appearance. The equipment shall be stored in a clean, dry location free from construction dust, precipitation and excess moisture. If stored for more than two weeks, the equipment shall receive all maintenance considerations required by the manufacturer for proper storage of the equipment.

1.07 TOOLS AND SPARE PARTS

- A. Furnish one set of all special tools required for the proper servicing of all equipment supplied under these specifications
- B. Furnish all spare parts not including required lubrication as recommended by the manufacturer for one year's normal operation and maintenance of the equipment. As minimum, one spare set of seals and gaskets shall be included for each size of drive.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The equipment herein specified is intended to be standard mixing equipment of proven ability as manufactured by reputable concerns having experience in the production of such equipment. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed as shown on the drawings.

- B. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially adapted for the work to be done.

2.02 MANUFACTURERS

- A. The mixers shall be ANCO MIXER Series 3340 as manufactured by Enviropax, Inc. of Salt Lake City, Utah, or engineer approved equal.

2.03 MATERIALS

- A. All submerged parts including the mixer shaft and impeller shall be constructed of type 316 stainless steel. All fasteners required for assembly of submerged parts shall be type 316 stainless steel.

2.04 DESIGN CRITERIA – RAPID MIX BASIN

A. Nbr of Mixers	Two
Width	6'-8"
Length	6'-0"
Side Water Depth	10'-3"
Freeboard	2'-0"
B. Impeller	
Type	axial – mix
Number per Shaft	1
Number of blades, min.	4
Diameter, min.	36"
Speed (RPM), max.	114
Tip speed (ft/sec), max.	13.0
Pumping Rate (GPM), min.	24,550
C. Shaft diameter, min.	4.5

D. Motor horsepower, min.	10
E. Motor speed (RPM), nom.	1800
F. Velocity Gradient (sec ⁻¹), min.	520
G. Design Water Temperature	50° F

2.05 DRIVE ASSEMBLY

- A. The mixer drive consisting of a speed reducer and motor shall be factory mounted to an open type extended pedestal base. It is intended that the extended pedestal base be manufactured in the same factory as the mixer assembly to insure the proper fitment of mixer components. The pedestal base shall elevate the oil drain on the speed reducer at least one foot above the mixer mounting surface so that oil can be conveniently drained by maintenance staff without the use of pumps. The pedestal base shall also provide access to the low speed impeller shaft coupling above the mounting platform and shall be designed to allow removal of the drive assembly without lifting or removal of the impeller shaft assembly. The base shall be made from ASTM A36 carbon steel and shall be painted in accordance with the specifications. Mixer designs not incorporating a pedestal base with the features cited herein will not be approved.
- B. The speed reducer shall be a parallel shaft, all helical gear design or right angle helical - spiral bevel gear design. Worm gear drives are not acceptable. The gearbox shall be suitable for AGMA class II 24-hour continuous service under moderate shock conditions in an outdoor environment. The reducer case is to be manufactured of high strength grey cast iron, SAE Class 30 (plastic housings or covers not allowed). The gears shall be carburized to a hardness of 58-62 Rockwell C, and finish ground to a minimum AGMA Class 10 quality level to assure minimum backlash, noise, heat and a minimum 95 percent gearbox efficiency.
- C. The speed reducer shall be provided with a suitable lubrication system for all-weather starting and operation of the unit. A dipstick or sight glass shall be provided to observe oil levels. All fill and drain lines shall be sized for efficient functioning, and located for easy access. Oil changes, following the initial run-in period, shall not be required at less than 8,000 hour intervals. The low speed shaft shall be provided with an internal synthetic, spring loaded double lip seal, Dual external spring loaded double lip seals and a dry cavity between the seals which shall contain the lower grease lubricated output shaft bearings. The speed reducer breather shall be located above possible oil foam level. Other forms of lubrication, such as greasing of certain working parts within the speed reducer, are permissible provided adequate separation is made of these parts from oil lubricated parts. General maintenance, specifically including motor changes, and oil system maintenance including oil changes, shall not require the removal of the speed reducer from its foundation. The speed reducer shall be provided with lifting lugs suitable for lifting the complete mixing unit.
- D. Mixer drive main gearbox bearings shall be designed for a minimum rated L₁₀ life of 100,000 hours, with the output bearings rated for 300,000 hours.
- E. The thermal rating of the speed reducer shall exceed the mechanical rating to eliminate the need for external coolers.

- F. The speed reducer shall have a minimum service factor of 5.0 based on the motor nameplate horsepower rating.
- G. The full load operating noise level of the gear reducer shall meet the more stringent requirements of current OSHA occupational noise standards or AGMA 299.01, and shall not exceed 85 dBA at a distance of three feet from any part of the drive assembly.

2.06 MOTOR

- A. The mixer drive motors shall be severe duty, high efficiency, totally enclosed fan cooled, designed for operation with a variable frequency drive. The motor shall be designed for continuous operation in a 40°C ambient temperature environment with the horsepower ratings and speeds specified. The motors shall have a 1.15 service factor on across the line starting and a service factor of 1.0 when operating on PWM power. The motors shall be suitable for inverter duty and have a Class F insulation rating.
- B. Motors shall have the following characteristics in addition to those described herein:
 - 1. Enclosure TEFC
 - 2. Nominal synchronous (60 hertz speed) 1,800 RPM
 - 3. Voltage 460 volts
 - 4. Phase 3
 - 5. Nominal frequency 60 hertz

2.07 LOW SPEED COUPLING

- A. A flanged coupling assembly shall be used for connecting the gearbox output shaft and the vertical impeller shaft. The upper coupling half shall be keyed on the speed reducer output shaft and shall be held in place by a retainer washer and bolt in the end of the gearbox output shaft. The lower mixer shaft coupling half shall be welded to the mixer shaft.
- B. The coupling halves shall be either cast or machined from solid round bar of the wetted material specified. The couplings shall be turned and faced to provide a precision machined register fit. The coupling assembly shall be designed to transmit 200 percent of the full torque and 150 percent of the axial load on the coupling.
- C. The coupling halves shall be bolted together through the flanges with plated bolts. The Contractor shall submit with the shop drawings details of the coupling-shaft sleeve arrangement for the Engineers review and acceptance.

2.08 IMPELLER SHAFT

- A. The impeller shaft shall be solid bar sized so the maximum operating speed of the impeller and shaft assembly does not exceed 70% of the first natural critical speed. The weight of both the shaft and the impeller assembly shall be taken into account in calculating the critical speed. The shaft diameter shall be determined by an analysis of shaft stresses caused by torque and bending moments as well as critical speed but shall in no case be less than indicated herein. The combined shaft stress shall not exceed 8,000 psi. The mixer shaft shall be straightened to within ¼ inch for every ten feet of length.

2.09 IMPELLER ASSEMBLY

- A. The impellers shall be of the axial flow type. The assembly shall be made up of an impeller hub with welded on blades. Axial flow impellers shall have a hub with not less than 4 blades evenly spaced on the hub having a minimum outside diameter specified herein. All mill scale, rust, and contaminants shall be removed. Sharp corners, cuts or sheared edges shall be dulled by a power grinder or file.
- B. The assembled impeller shall be attached to the shaft using a hook-key design to transmit the torque and support the weight of the impeller. The design of the hook-key feature shall be such that with the impeller hub set screw loosened, the impeller cannot slide down the impeller shaft during installation.

PART 3 - EXECUTION

3.01 FACTORY TESTING

- A. The mixers shall be fully assembled at the factory to insure proper fit-up of all components, and then operated to check for noise and vibration.

3.02 INSTALLATION

- A. Install in accordance with the manufacturers written instructions and as approved.

3.03 3.03 FIELD INSPECTION AND TESTING

- A. After completion of installation, the equipment shall be tested by the contractor under actual operating conditions. The tests shall demonstrate that the system and individual equipment items operate properly and in all other respects fulfill its function properly and meets all requirements of the specifications. The mixer manufacturer shall provide one (1) trip of field service with one (1) day onsite for startup services.

SECTION 46 41 17

STATIC MIXER

PART 1 - GENERAL

1.01 SUMMARY

- A. The static mixer system is designed to achieve homogeneous mixing of raw water (untreated) and finished water (treated) in a water treatment pipeline, with provisions for chemical dosing to support processes such as chlorination, pH adjustment, coagulation, or flocculation. The system includes two mixer types: a multi-element static mixer for primary mixing and a wafer-style static mixer for compact, high-turbulence mixing in space-constrained sections. The mixers are motionless, requiring no external power, and utilize the flow stream's energy for mixing.
- B. Section includes general requirements for valves used in process piping systems including:
 - 1. In-line Multielement Static Mixers
 - 2. Wafer Style Static Mixers

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 01 33 00 - Submittal Procedures
 - 2. Section 40 05 00 - Common Work Results for Process Interconnections
 - 3. Section 46 05 00 - Common Work Results for Water Equipment

PART 2 - PRODUCTS

2.01 DESIGN

- A. Flow Rate: 1,500–7,000 GPM (gallons per minute)
- B. Pipeline Diameter: See plans.
- C. Fluid Velocity: 0.5–5 ft/sec to ensure adequate mixing energy.
- D. Pressure Drop: Minimized to reduce pumping energy costs
- E. Operating Pressure: 50 psi

- F. Operating Temperature: 40–100°F (fluid temperature).
- G. Mixing Efficiency: Coefficient of Variation (CoV) <0.05 at mixer outlet to ensure homogeneity.
- H. Mixer Configurations – Multi-Element Static Mixer

- 1. Design

- a. Type: Housed-elements static mixer with fixed, helical or blade-style mixing elements.
- b. Elements: 6–12 helical or patented blade elements for turbulent flow mixing.
- c. Element Geometry: Twisted 180° per element, alternating right and left twists to promote flow division, radial mixing, and inversion.
- d. Length: 1.5 times the pipe diameter per element

- 2. Materials:

- a. Housing: Ductile Iron
- b. Elements: Stainless steel.

- 3. Features:

- a. Flanged end connections (ANSI 150#) for easy integration into existing pipelines.
- b. No moving parts, ensuring maintenance-free operation.
- c. NSF-certified for potable water applications

- 4. Performance:

- a. Suitable for high-flow, turbulent-flow applications.
- b. Low pressure drop.
- c. Effective for mixing miscible fluids and dispersing additives with varying viscosities.

- I. Wafer-Style Static Mixer

- 1. Design

- a. Type: Compact, drop-in wafer mixer designed for space-constrained installations.
- b. Elements: 1 vortex-generating element creating three-way counter-rotating vortex pairs.
- c. Profile: Slim, fitting between pipe flanges (2–4 inches in length for 12” pipe).
- d. Mixing Mechanism: High turbulence via vortex generation and counter-flow injection, achieving rapid dispersion in short distances.

- 2. Materials:

- a. Housing: Ductile Iron
 - b. Element: 304 Stainless steel
- 3. Features:
 - a. Clamps between existing pipe flanges (ANSI 150# or DIN standards) or at the end of a flanged pipe.
 - b. Minimal pressure drop
 - c. NSF-certified for potable water applications
- 4. Performance:
 - a. Ideal for turbulent flow dosing and blending in pre- and post-treatment stages.
 - b. High mixing efficiency in compact spaces, with CoV <0.05.
 - c. Suitable for pipelines 2"–120" in diameter.

J. Chemical Injection System

- 1. Injector Type: Removable injection lances or centerline/sparger injectors for precise additive dosing.
- 2. Number of Injectors: 1–3, configurable
- 3. Injector Design:
 - a. Centerline Injector: Introduces chemical at the mixer's centerline for rapid dispersion.
 - b. Injection Ports: Male/female NPT or flanged connections (1/2"–2" diameter) for compatibility with dosing pumps.
 - c. Materials: Stainless steel, PTFE, or PVC to resist corrosion from chemicals like sodium hypochlorite, alum, or acids.
- 4. Features:
 - a. Provide as shown on plans.
 - b. No small release holes to prevent clogging
 - c. Corporation stops for removal

K. Submittals:

- 1. General Arrangement (GA) drawing
- 2. Installation, Operation, and Maintenance Manual

L. Manufacturer:

1. Koflo
2. Ross
3. Approved Equal

PART 3 - EXECUTION

- A. Warranty: 12 months from substantial completion
- B. Installation and Maintenance
 1. Multi-Element Mixer: Inline installation with flanged connections, no upstream/downstream straight pipe required.
 2. Wafer Mixer: Drop-in installation between pipe flanges, or attach to end of flanged pipe.
 3. No moving parts, ensuring maintenance-free operation.
 4. Removable injection lances for cleaning under full pressure.
- C. Quality Assurance and Testing
 1. Full visual inspection and dimensional check before shipment.
 2. Quality Assurance:
 3. Designed and manufactured to ISO standards.
 4. Compliance with industry standards for water treatment (e.g., AWWA, ASME).

END OF SECTION

SECTION 46 61 33

CERAMIC MEMBRANE SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. The Ceramic Membrane system has been designed with pre-selected equipment manufacturers and models which have design/performance features, characteristics, or capabilities that are essential and required to accomplish the project. The pre-selected membrane technology has salient support, physical, functional, or other characteristics which are essential to ensure that the intended use of the item can be satisfactorily realized.
- B. The Contractor shall assure the Ceramic Membrane System Supplier and Membrane Manufacturer shall conform to the Basis of Design performance specifications contained within this section and must fit within the space allocated on the design drawings. The Contractor shall be responsible for all costs associated with alternate layouts, equipment supply or services, as well as any associated re-design fees.
- C. Ovivo USA, LLC as the Basis of Design Ceramic Membrane System Supplier and Membrane Manufacturer.
 - 1. Ovivo USA LLC Contact: Mark Machacek, email: mark.machacek@ovivowater.com, phone: (801)518-1666.
- D. Cerafiltec US is a preapproved equipment manufacturer. The Contractor shall provide any changes to the design Specifications or Drawings with no additional cost to the Owner as described in "B" above.
 - 1. Cerafiltec US Contact: Lee Pope, email: lee.pope@itac.us.com phone: (770) 634-0863.

1.02 RELATED DOCUMENTS

- A. Construction Drawings and general provisions of the Contract, including the General and Supplementary Conditions.
- B. Related Specifications
 - 1. Section 40 05 19 – Ductile Iron Process Pipe
 - 2. Section 40 05 23 – Stainless Steel Process Pipe and Tubing
 - 3. Section 40 05 31 – Thermoplastic Process Pipe
 - 4. Section 40 05 51 – Common Requirements for Process Valves
 - 5. Section 40 05 57 - Actuators for Process Valves and Gates

1.03 DEFINITIONS

- A. **Assessment Fee:** An Assessment Fee is a fee that is implemented to account for commercial impacts in which a membrane technology may impose on funding or lifecycle costs. The Assessment Fee is to be collected and paid directly to the owner.
- B. **Backwash:** Synonymous with backpulse and backflush. A Backwash is any instance where water and/or a chemical solution are charged to the membranes in the reverse direction of normal permeate flow, at sufficient flow to dislodge solids accumulation. A Backwash is performed in-situ.
- C. **Chemically Enhanced Backwash (CEB):** Synonymous with chemically enhanced backwash.
- D. **Clean In Place (CIP):** See Maintenance Clean and Recovery Clean.
- E. **Ceramic (membrane):** A material containing Silicon Carbide. Grains of silicon carbide are bonded together by the sintering process to form a very hard monolithic ceramic product requiring high endurance. Silicon Carbide membranes are monolithic in construction, hydrophilic and will not degrade when exposed to chemicals.
- F. **Flux:** Gallons of permeate flow per day per square foot of membrane area (gfd). Additional definitions of flux that are used to characterize design criteria and membrane performance include:
 - 1. **Instantaneous Flux:** Calculated by dividing measured permeate flow rate by working membrane area at any instant.
 - 2. **Gross Flux:** See Instantaneous Flux.
 - 3. **Net Flux:** Calculated by dividing the total amount of permeate produced (available for discharge) in a given time frame by the working membrane area.
- G. **Hydrophilic:** Membrane units which are naturally hydrophilic without the use of additives
- H. **In-Situ:** Inside the normal service area and submerged in feed water.
- I. **Log Removal Value (LRV):** Reduction value of cryptosporidium and giardia
- J. **Maintenance Clean (MC):** One type of CIP, not as strong as a Recovery Clean. A Maintenance Clean is performed in-situ. The procedure is conducted by charging cleaning chemicals to membranes in the reverse direction of permeate flow with a soak time lasting more than 0.5hr.
- K. **Mechanical Cleaning:** Synonymous with manual cleaning, phyal cleaning and hand cleaning. Mechanical Cleaning is any instance where membranes are cleaned by hand or machine (water jetting or other) for the purposes of removing fouling or localized dewatering.
- L. **Membrane Element:** An element is comprised of either a plate, sheet or hollow-fiber filament. The elements are combined to make a Membrane Module.
- M. **Membrane Manufacturer:** The company responsible for the production of the smallest membrane subunit which is then incorporated into a module and membrane unit.
- N. **Membrane Material:** Membrane materials are either Polymeric or Silicon Carbide based.

- O. Membrane Module: The module is comprised of multiple membrane plates, sheets or hollow fibers which are combined and assembled in a module frame. The modules may be modular and are generally assembled into a complete Membrane Stack (Unit). A module may also be considered a membrane cassette.
- P. Membrane Stack (Unit): May also be considered a membrane unit or large membrane subunit consisting of one or more membrane modules and an integral air scour diffuser system.
- Q. Membrane Basin (Tank): One isolatable unit of the overall membrane facility that may contain one or more parallel rows of membrane units. The Membrane Basin shall be capable of draining and filling as a single entity.
- R. Membrane Train: The part of the overall membrane system which is associated with a single membrane basin. One of multiple functional units of the membrane system that operates in parallel, and distinctly, from other trains, and that includes: one or more sub-trains of large membrane subunits located within a single membrane basin and each sub-train being made up of one or more parallel rows of large membrane subunits; one or more permeate headers and pumps with one permeate pump and one air supply blower per membrane sub-train. A train operates as a single entity for operation, backwashing/backpulsing, relaxing, maintenance or cleaning.
- S. Monolithic Membrane: A membrane element which is produced as a single mass from one material, consisting of a uniform filtration layer and a drainage layer.
- T. Permeability: Equals the instantaneous flux rate divided by the transmembrane pressure (TMP). The units of permeability are gfd/psi.
- U. Polymeric (membranes): Polymeric membranes are principally made from various polymer materials such as PAN, PE, PES, PS, PTFE and PVDF. Polymeric membranes are hydrophobic and will degrade with exposure to MC chemicals.
- V. Plant Hydraulic Loading Criteria: The net permeate flow rate over a given period of continuous operation accounting for CIP procedures and relaxation.
- W. Process Train: A stand-alone combination of Process Zones designed and operated to achieve specific treatment objectives.
- X. Readiness of Shipping: Is the date that the equipment has been fabricated, assembled and staged, ready to ship to the location for installation or storage.
- Y. Recovery Clean: One type of CIP, stronger than a Maintenance Clean. A Recovery Clean is performed in-situ or ex-situ and in water with chemicals. A Recovery Clean is any single membrane basin clean that lasts for more than 1.0 hours. The procedure is conducted by charging cleaning chemicals to membranes in either direction with variable soak times.
- Z. Silicon Carbide (membrane): A material containing silicon carbide. Grains of silicon carbide are bonded together by the sintering process to form a very hard monolithic ceramic product requiring high endurance. Silicon Carbide membranes are monolithic in construction, hydrophilic and will not degrade when exposed to chemicals.
- AA. Transmembrane Pressure (TMP): The effective pressure differential across the membrane during normal operation.
- BB. Work: A general description for providing Goods and Special Services.

1.04 DESCRIPTION OF WORK

- A. This Section specifies the requirements for the furnishing, installing, testing, training, startup, and warranty support of all process equipment required for a submerged ceramic membrane system for the treatment of drinking water.
- B. The Ceramic Membrane System Supplier shall furnish and commission the Membrane Sub-system as described in this specification, inclusive of all equipment, instrumentation, scope-specific piping systems, controls, integration, and warranty support.
- C. The Ceramic Membrane System Supplier shall provide the Ceramic Membrane Product Engineering and Design Services in support of the treatment system design as described in this specification.
- D. The Contractor shall furnish all labor, rigging, materials, and incidentals required for the installation of the Ceramic Membrane System in accordance with the installation instructions provided by the Supplier. Once installed, the Ceramic Membrane shall be complete and operational with all control equipment and accessories as specified herein and described in the Contract Documents.
- E. The Engineer is responsible for coordinating the Work with the services of others involved in the project. The Engineer shall decide as to the quality and acceptability of services and materials furnished and Work performed. All questions which may arise as to the interpretation of any or all Plans and Specifications and all questions as to the acceptable fulfillment of the Contract on the part of the Contractor and Suppliers shall be resolved by the Engineer.
- F. The Ceramic Membrane System Supplier must clearly identify in detail any and all exceptions to the Services and Scope of Supply described in this Specification.

1.05 QUALITY ASSURANCE QUALIFICATIONS

- A. All the furnished equipment and services specified under this Section shall be standard units of proven ability as manufactured and integrated by competent companies that are fully experienced, reputable and qualified in the integration and manufacture of the equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed.
- B. The Ceramic Membrane System Supplier and Membrane System Manufacturer shall demonstrate their quality of performance, timeliness of performance, customer satisfaction, on-budget performance, ability to minimize change orders, ability to prepare plans, technical capacity, qualifications, and ability to assess and minimize risks.
- C. To show evidence of being able to provide the quality of equipment and services described in this specification, the Membrane System Supplier shall have an ISO 9001:2015 certification for the specific location(s) the Ceramic Membrane System will be designed, executed and supported. The company identification and quality procedures shall indicate for the Ceramic Membrane System Supplier that the Quality Management System is applicable to design, manufacturing, supply, installation, and servicing of water treatment plants, associated equipment. The quality system shall be audited by a third-party independent inspector. The certification shall remain in effect 2 years past the commissioning of the project.
- D. Membrane Manufacturing

1. All membrane units furnished under this Section shall be new and unused and shall be the standard products of a Membrane Manufacturer having a successful record of manufacturing the proposed membrane technology for a minimum of six (6) years.
2. All membranes shall be NSF61 approved and have NSF419 certification of greater than 4 LRV.

1.06 SUBMITTALS

- A. Project Submittals: The Ceramic Membrane System Supplier shall submit to the Contractor and Engineer, complete manufacturer's descriptive information for all equipment, instrumentation, and components in the Supplier's and the Membrane Manufacturer's Scope of Supply. The Supplier is to provide digital copies of the submittals containing all submittal information organized by component, clearly marking options, models, materials, etc. The Project Submittal shall contain the following as applicable to the Ceramic Membrane System Supplier's scope:
1. Membrane installation drawings, detailing membrane unit dimensions, materials, weights, locations of lifting lugs/points, and anchor bolt locations.
 2. Ceramic Membrane basin mechanical layout drawings, detailing the number of membrane units, air and permeate piping distribution, piping supports, in-basin instrumentation and valves, and all other components comprising the Ceramic Membrane basin systems. Drawings will detail information in plan and elevation/section views and include details as necessary to completely describe the installation requirements. Drawings will be based on the basin/structural design provided by the Engineer.
 3. Plan view equipment within the membrane basin and instrument drawings showing the location of all components provided by the Ceramic Membrane Supplier. Locations and installation details are to be coordinated with the Engineer's drawings to avoid conflicting information.
 4. Manufacturer's literature for all equipment in Ceramic Membrane Suppliers scope of supply.
 5. Where manufacturers' standard literature is submitted, it shall be clearly marked to indicate which features are to be furnished under this contract.
 6. Process and Instrumentation Diagrams (P&IDs) showing all equipment and instrumentation which will be controlled by the Ceramic Membrane suppliers control system, including components provided by others. PIDs will differentiate which components are supplied by Ceramic Membrane Supplier. Unless otherwise directed by the Engineer, the Ceramic Membrane supplier is responsible for establishing the tagging scheme for the P&IDs. Tagging scheme will assign a unique tag to all components and their associated I/O. Tagging scheme will organize components by subsystem and train.
 7. Instrumentation list and manufacturers' literature and cut sheets, clearly identifying manufacturers, models, ranges, materials of construction, installation details, power supply voltage, wiring information.
 8. Valve list and manufacturers' literature and cut sheets, clearly identifying manufacturer, models, valve flow coefficient (Cv) range, materials of construction, pressure rating, and dimensions.

9. Valve actuator manufacturers' literature and cut sheets, clearly identifying models, motor horsepower and voltage, control wiring, installation/connection details, torque rating, actuation times, duty cycle, and materials of construction.
 10. Control panel drawings, detailing the interior and exterior layouts, components, panel dimensions, and panel materials of construction and NEMA rating.
 11. Control panel component manufacturers' literature, clearly denoting model numbers of all PLC components, relays, terminal blocks, power supplies, buttons, switches, fuse blocks, etc.
 12. Control panel wiring schematics.
 13. Warranty information, detailing membrane design fluxes for all seasonal flow conditions.
 14. System start-up and commissioning procedures.
- B. Installation and Operations Manual (IOM): The Ceramic Membrane Supplier shall furnish an Installation and Operations Manual at least 2 weeks prior to the delivery of the Supplier's equipment on site. The IOM will include Supplier and manufacturer's manuals and drawings detailing dimensions, locations, wiring information, and any other information necessary to convey the correct assembly and installation of the Ceramic Membrane System components provided by the Supplier and Manufacturer. In addition to installation documents, the IOM shall include requirements for the Mechanical Inspection and a schedule of events for the System Commissioning. The Supplier is to provide digital access to the IOM containing all information organized by component.
- 1.07 WORK BY OTHERS
- A. The following work and scope of supply is specifically excluded from the Ceramic Membrane Supplier scope:
1. Design and Engineering:
 - a. Architectural.
 - b. Buried pipe, including soil requirements, thrust blocks, galvanic protection.
 - c. Concrete basins.
 - d. Wall penetrations
 - e. Support of piping outside of Ceramic Membrane scope.
 - f. Seismic design or calculations other than for seismic anchorage of the membrane units.
 - g. Equipment design and supply outside of the Ceramic Membrane Supplier's Scope.
 - h. Sealing calculations and drawings.
 - i. Overall treatment system design
 - j. Permitting and interaction with regulatory agencies.

2. Structural:
 - a. Building(s) for housing Ceramic Membrane equipment.
 - b. Concrete tankage for process and/or membrane basins.
 - c. Imbedded wall spools, pipe sleeves, pipe seals in concrete basin walls for the various process pipe connections/penetrations.
 - d. Covers or grating over process and/or membrane basins.
 - e. Equipment access platforms, walkways, stairs, etc.
 - f. Protective coatings for concrete.
 - g. Anchor bolts
3. Mechanical:
 - a. Permeate piping downstream of permeate header isolation valve and/or tie point as identified in the Contract Drawings.
 - b. Process air piping.
 - c. Air scour supply piping upstream of tie point as identified in the Contract Drawings.
 - d. Membrane CIP piping, including branch connections and headers.
 - e. Pipe supports and hangers unless otherwise noted.
 - f. Hoist equipment above the membrane basin for installation and removal of the membrane subunits.
 - g. Installation of any kind, including equipment and piping outside of Scope of Supply designated tie points.
 - h. Installation materials for instrumentation and automatic valves, including, but not limited to, air / sample line tubing, fittings, and mountings outside of Scope of Supply designated tie-points.
 - i. Freeze protection
 - j. Cathodic protection
4. Electrical:
 - a. Electrical wiring interconnections (including wiring, conduit and other appurtenances required to provide power connections as needed) from the electrical power source to the Ceramic Membrane System Control Panel.
 - b. Electrical wiring interconnections (including wiring, conduit and other appurtenances required to provide power connections as needed) from MCC to all field equipment.

- c. Instrumentation wiring, conduit and other appurtenances required to provide connections as needed between the terminal boxes at the Ceramic Membrane Basins and skids, loose pumps, etc., and the membrane PLC control panel.
 - d. Motor control centers, variable frequency drives, motor starters, panel boards, transformers, and other equipment necessary to provide power distribution and control for all equipment.
 - e. Network communications connection to the Plant SCADA and the Ceramic Membrane System SCADA systems (if the two are different).
5. Other:
- a. Receiving, unloading and safe storage of equipment at site or a storage facility until ready for installation.
 - b. Onsite basin, tank, skid and equipment installation.
 - c. Instrumentation installation including continuity checks and assistance with related loop checkout.
 - d. Raw materials, chemicals and utilities during equipment testing. This includes potable water for system function testing per supplier requirements.
 - e. Laboratory services, operating and maintenance personnel during equipment checkout, startup and operations.
 - f. Onsite painting or touch-up painting, with the exception of painting required due to damage incurred prior to equipment being received onsite.
 - g. A factory-based engineer or representative for startup of system components, other than membrane system supplier representatives, to commission any equipment being supplied.
 - h. Spare parts, other than specified

1.08 WARRANTY

A. General

1. The warranty period shall begin following completion of the System Commissioning as specified herein or not to exceed 6 months past equipment readiness for shipment plus the warranty period.
2. The Ceramic Membrane System Supplier is solely responsible for identifying water quality parameters, instrumentation and control programming required to satisfy and maintain warranty provisions.
3. For the duration of the warranty, the Owner shall maintain a high-speed connection to the processor and allow the Ceramic Membrane System Supplier to monitor and record all data available.
3. Any event or instance where connectivity is lost or where one or more operating parameters are non-conforming per Contract Documents for a period of one consecutive hour or for a total of six hours or less in each calendar year, shall not reduce or void the membrane warranty.

4. In the event that the Owner does not believe that the Goods meet the Contract Documents, the Owner shall notify the Ceramic Membrane System Supplier that the conditions may exist for a breach of guarantee.
 - a. For warranty claims the Supplier shall provide an acceptable remedy to the Owner in accordance with the contract documents.
 - b. All on-site support required for the warranty, as defined in the warranty statement, shall be coordinated by the Ceramic Membrane System Supplier directly with employees of the supplier. Subcontractors of the supplier shall not provide warranty coordination or support.
5. Should the system at any time be operated outside of warranty compliance parameters, the warranty may be reinstated upon satisfactory completion of a Supplier inspection at the expense of the Owner and a return to operation within parameters.
6. The supplier shall provide phone support for the Ceramic Membrane System for two years following the successful completion of System Commissioning. Phone support shall be available 24 hours a day, 7 days a week.

B. Membrane Module Warranty

1. The Ceramic Membrane System Supplier warrants that the membrane modules will be used for treatment of drinking water
2. Ceramic Membrane System Supplier Membrane Module Warranty Period shall be a minimum warranty period of 120 months after date of commissioning or 6 months plus 120 months from shipment readiness, whichever occurs first.
 - a. The supplier shall repair or replace any membrane element or module that fails during the warranty duration.
 - b. If a replacement is necessary as determined by the Ceramic Membrane System Supplier, the first 24 months shall be a full replacement, with the remaining 96 months pro-rated.
 - c. Any membrane modules replaced under warranty shall assume the remaining warranty of the membrane modules.
 - d. Membrane replacement may be with new or modified designs.
3. If membrane modules are found to be defective after final acceptance, the Ceramic Membrane System Supplier is responsible for correcting the issue.
4. In order to maintain the provisions of the membrane module warranty, the Owner agrees to the following:
 - a. Installation and maintenance of an automated data acquisition system is required. Owner shall acquire and maintain the appropriate hardware/equipment to allow for continuous remote monitoring and data acquisition. Failure to obtain and maintain such a system resulting in <10% of operating data to be lost shall void the warranty.
 - b. The data acquisition system shall monitor, record and trend:
 - i Plant Flow (total, and each membrane train).
 - ii TMP.
 - iii Pressure (each membrane train).
 - iv Permeate Turbidity (each membrane train).

- v Temperature.
 - vi pH.
 - vii Water depth (each membrane train).
- c. The Owner will maintain a hand-written log if an occurrence develops that is totally outside the bounds of routine and normal operation or automated operation.
 - d. The Owner shall maintain records regarding:
 - i Date and time membranes are taken out of service or cleaned.
 - ii Chemical concentration, amount of chemical per treatment and soak time.
 - iii Turbidity, weekly.
 - iv In the event of the warranty claim, the Owner shall provide the Ceramic Membrane System Supplier with these written logs and if no access to the processor was available to the Ceramic Membrane Supplier all required historical electronic data shall be supplied.
5. The Ceramic Membrane System Supplier warrants that the membrane modules will be free from non-conformance in materials, workmanship, membrane integrity failure, and irreversible flux loss.
- a. Failure is defined as (i) inability to meet production capacity requirement as specified herein, or (ii) inability to meet TSS/Turbidity requirements as specified herein.
6. Limitations of Membrane Module Warranty. Owner recognizes that the occurrence of any of the following shall void the remaining membrane module warranty.
- a. Phyal damage or faulty installation of the membrane modules by others.
 - b. Unauthorized alteration of components manufactured by Ceramic Membrane System Supplier.
 - c. Exposure to chemical or phyal conditions outside of the recommended operating range for the membrane modules. Examples of such conditions include:
 - i Inappropriate operation of the system that results in exposure of the membrane modules to suspended solids concentrations in excess of design values, for more than 24 hours greater than three times per year or a cumulative total of 72 hours.
 - ii Catastrophic exposure to chemicals not normally associated with water treatment as a result of accidents, vandalism or other acts outside the bounds of routine and normal treatment plant operation.
 - iii Use of chemicals or cleaning procedures other than those recommended and approved by the Ceramic Membrane System Supplier.
 - d. Improper maintenance of equipment. Examples of such conditions include:
 - i Operating outside of the established design parameters and the Ceramic Membrane System Supplier's established operational and maintenance guidelines.
 - ii Failure of the Owner to maintain electronic and hand-written operational logs.
 - iii Introduction of foreign debris >2.1 mm in diameter into the membrane basin is not permitted. This includes debris that can enter the membrane basin directly from the external environment as well as debris present in the water itself.

- iv All screen bypass events void the membrane warranty and must be reported to the Ceramic Membrane Supplier. In the event of a screen bypass event, the following procedure must be followed:
 - a) Drain and inspect basins.
 - b) After damaged membranes are repaired or replaced and chemical cleaning performed, a 2-week evaluation will be performed to determine if all adverse effects of screen bypass event have been remedied.
 - v Failure to perform Chemically Enhanced Backwashes, Maintenance Clean, or Recovery Clean per Ceramic Membrane System Supplier's O&M.
 - vi Failure to perform routine integrity tests on membranes to determine if any damage has occurred.
7. If there are damaged membranes, not covered under warranty, the damaged membranes are to be replaced at Buyer's cost.
 8. If within sixty (60) days after notification to the Ceramic Membrane System Supplier it has become apparent to the Owner that membrane modules are not able to meet the provisions of the warranty, the Owner may pursue a breach of warranty claim or other available remedies. Ceramic Membrane System Supplier shall be allowed a minimum of three (3) months to implement a remedy to operational issues and meet performance criteria including repairing existing membrane modules, membrane replacement, and or making operational changes.
- B. Ancillary Equipment Warranty
1. The supplier shall warrant all other new equipment, not specifically mentioned above, against defects in workmanship and materials for a period of 1 year, not to exceed 1 year and 6 months from notification of equipment ready to ship.

PART 2 - PRODUCTS

2.01 CERAMIC MEMBRANE PRODUCT ENGINEERING AND DESIGN SERVICES

- A. The Ceramic Membrane System Supplier will provide the following design services related to the Ceramic Membrane product under a separate contract between the Owner and Supplier:
1. Equipment Sizing and Installation Details – The Ceramic Membrane Supplier shall verify duty points and turn-down, supply voltages, materials of construction, communications IO, equipment access and serviceability, area classifications, and pressure ratings for the Ceramic Membrane system's pumps, blowers, mixers, and valves. In addition to identifying manufacturers and specific part numbers for each component, installation details and 2D/3D CAD blocks shall be provided for integration into the Engineer's design package.
 2. Instrumentation Design – The Ceramic Membrane Supplier shall provide the Engineer with complete specification and documentation of all Ceramic Membrane system instrumentation. Each instrument's manufacturer, model, size, range, power, communications protocol, units, materials, connections, and area classification shall be documented in ISA Specification forms. Installation details shall be provided in AutoCAD format for integration into the Engineer's design package.

3. Controls Design – The Ceramic Membrane Supplier shall supply Ceramic Membrane system Process and Instrumentation Diagrams utilizing the Supplier’s standard symbols and tagging schemes, Ceramic Membrane system control panel layout/fabrication details, and Ceramic Membrane system control panel wiring schematics in AutoCAD for integration into the Engineer’s design package. Additional controls documentation shall include PLC architecture diagrams, control panel BOM, panel IO arrangement, loop drawings, and a control narrative of the overall plant control scheme.
4. Specifications - Using CSI MasterFormat 2016, the Ceramic Membrane System Supplier shall provide the Engineer with complete bid specifications for the Ceramic Membrane system and all supporting equipment, instrumentation, piping systems, valves, and control systems within the Ceramic Membrane System Supplier’s scope, for integration into the Engineer’s contract and bid documents.

2.02 SYSTEM PERFORMANCE REQUIREMENTS

A. General

1. Ceramic Membrane Basin Configuration and Size
 - a. The allowable Suspended Solids concentration in the Membrane Basin shall not be more than 1,000 mg/L.
 - b. Site constraints mandate the basin configuration and size are as specified without exception. No item of size, material or equipment will be considered by the Engineer as a substitute or “or-equal”.
 - 1) The Ceramic Membrane train configuration shall:
 - a) Be of two trains.
 - b) Fit within the space allocated.
 - c) Operate at a Side Water Depth of no more than 9.17 feet.
2. Process Basin Configuration and Size
 - a. Existing basins will be retrofitted as shown in the plan drawings.
 - b. The process flow will be as shown in the drawings.
3. Site Conditions
 - a. Ambient air temperatures shall be between 50°F and 90°F .
 - b. The elevation above sea level is 290 ft.
 - c. The influent water pH shall be between 6-8 SU.

B. Design Criteria

1. The Membrane System shall be configured to hydraulically meet flows below.
 - a. Design Flow: 2.0MGD

2. The Membrane System shall be capable of treating Surface water at listed flows to the specified effluent criteria shown in Table 2-1.

Table 2-1: Feed Water and Effluent Criteria

Parameter	Influent	Treated water	Comment
Turbidity	<1.0 NTU	≤ 0.1 NTU	
TSS	2 mg/L		
TOC	N/A	--	Not reported
DOC	N/A	--	Not reported
Iron	N/A	--	Not reported
Magnesium	N/A	--	Not reported
pH	N/A	--	Not reported
Minimum Temperature	xx°C		Feed water temperature
Maximum Temperature	xx°C		Feed water temperature

2.03 SUBSYSTEM SCOPE OF SUPPLY

A. General

1. Ceramic Membrane System Supplier shall furnish the Subsystem Components listed below in accordance with the requirements of the project Specifications and Contract Documents. All components shall be shipped loose for installation by installing Contractor unless otherwise noted.

B. Membrane Basins.

1. Membrane Stacks or Units.
2. The ceramic membrane system supplier shall provide:
 - a. In-basin membrane air and permeate drop pipes.
 - b. Each membrane unit shall have an isolation valve on the permeate, spray wash, and aeration pipes.
 - c. All main headers in-basin, above or to the immediate exterior of the basins terminating with a flange connection (or Straub-style coupling) at the end of the basin.
3. Membrane support structures
 - a. Ceramic Membrane System Supplier shall provide the basin mounting supports for the membrane units.

4. Basin level transmitter and switch

C. Permeate Collection System

1. Permeate pumps, 1 duty per train
2. Each piece of equipment shall be provided with shut-off valves or mechanisms so that it may be isolated or bypassed, while still providing system operation to take place.
 - a. Pump check valves. 1 per pump.
 - b. Pump isolation valves. As required, typically 2 per pump.
3. Permeate flow control.
 - a. VFD control shall be provided by others for each permeate pump.
 - b. Actuated On/Off Control valve(s). Typically, 2 per train (1 for permeate control, 1 for backwash control), plus 1 for Backwash Basin fill.
4. Permeate process instrumentation.
 - a. TMP measurement. 1 per train
 - b. Flow meter. 1 per train
 - c. Turbidimeter. 1 per train
 - d. Gauges, 2 per pump (suction/discharge)
5. Air removal and priming system shall be designed and provided for each basin to remove air accumulation in the permeate pipes and to ensure automatic priming of the piping prior to start/re-start.

D. Air Scour Blowers

1. Air Scour Blowers, 1 duty and 1 installed standby.
2. VFD control shall be provided by others for each blower.
3. Scour air instrumentation for each unit.
 - a. Pressure relief.
 - b. Pressure gauge.
 - c. Air low flow switch, 1 total
4. Each piece of equipment shall be provided with shut-off valves or mechanisms so that it may be isolated or bypassed, while still providing system operation to take place.
5. Blower check valves. 1 per blower
6. Blower isolation valves. As required, typically 1 per blower

E. Membrane Cleaning Systems

1. Membrane cleaning system includes pumps, valves, instrumentation, and tanks. Membrane Backwash, Chemically Enhanced Backwash, Maintenance Clean and Recovery Clean systems shall be fully automated and have the following methods available to maintain production capacity and meet performance requirements specified herein.
2. Chemically Enhanced Backwash, Maintenance Clean and Recovery Clean systems shall include the following without exception:
 - a. Sodium Hypochlorite Injection System. 1 duty, 1 standby
 - 1) Actuated valves, typically 1 per basin
 - 2) Injection quills, typically 1 per basin
 - b. Citric or Oxalic Acid Injection System. 1 duty, 1 standby
 - 1) Actuated valves, typically 1 per basin.
 - 2) Injection quills, typically 1 per basin.

F. Controls

1. Membrane System control panel.
 - a. Programming update.
2. Membrane System operator interface.
 - a. HMI update.
3. Data Monitoring and Trending
 - a. Remote Connectivity, by others.

G. Operational Tools

1. Provide the following operational tools:
 - a. Membrane Lifting tool.

2.04 GENERAL EQUIPMENT DESIGN AND FABRICATION REQUIREMENTS

A. General

1. The Ceramic Membrane system has been designed with pre-selected equipment manufacturers and models which have design/performance features, characteristics, or capabilities that are essential and required to accomplish the project. The pre-selected membrane technology has salient physical, functional, or other characteristics which are essential to ensure that the intended use of the item can be satisfactorily realized. No membrane substitute exists that can meet the needs of the project.
2. When certain items of equipment and/or materials are specified and/or described as the product of a particular manufacturer together with any required additional information such

as model number, size or catalog number, only such specific items may be used in preparing the Bid.

3. All equipment that is in contact with potable water or water that is intended to become potable water shall be NSF 61 certified.

B. Membrane

1. The only membrane technology which has been pre-approved is the rigid flat plate membranes constructed from Silicon Carbide.
2. The maximum allowable net flux rate is 250 gallons/ft²/day, unless approved by manufacturer.
3. Membrane Life Assessment.
 - a. Membrane Life can be estimated based on the published maximum lifetime exposure to chlorine.
 - b. Membrane suppliers shall provide a guaranteed membrane replacement cost, valid for 20 years.
 - c. Membrane life in O&M cost calculations shall be based on published chlorine lifetime PPM exposure and flux design.
 - d. Membranes with a chlorine lifetime PPM hours exposure of:
 - 1) $\leq 800,000$ ppm/hrs shall have a 7-year replacement interval.
 - 2) 800,001 to 1,500,000 ppm/hrs shall have a 9-year replacement interval.
 - 3) 1,500,001 to 3,000,000 ppm/hrs shall have a 10-year replacement interval.
 - 4) $> 3,000,001$ ppm/hrs shall have a 20-year replacement interval.
4. Membrane Stack or Unit
 - a. Each Membrane Train shall consist of one or more Membrane Stacks/Units. Each stack or unit shall be:
 - 1) Constructed from Noryl/PPO frames.
 - 2) Prefabricated, preassembled and factory certified before shipment to the site.
 - 3) Provided complete, with all necessary components, accessories and appurtenances required to make a complete and operable system.
 - 4) Furnished with integral diffusers designed to promote efficient air scouring of Membrane Elements.
 - b. Small Membrane Subunits contain multiple Membrane Elements. Membrane Elements shall be:
 - 1) Elements are monolithic construction.

- 2) Assembled into a housing called a module.
- 3) Constructed such that the membranes are held vertically and firmly.
- 4) Manufactured using materials suitable for use in submerged Ceramic Membrane applications and:
- 5) Have an average pore size of 0.1 micron or less.

5. Design Basis

a.	Service:	Drinking Water
b.	Material of Construction (substrate):	Silicon Carbide
c.	Material of Construction (membrane):	Silicon Carbide
d.	Vickers Hardness – ASTM E2546:	35 (min)
e.	Hydrophilic Properties:	Naturally Hydrophilic <10° contact angle
f.	Log Removal Value – NSF419	>4
g.	Flux Design at N Condition (instantaneous):	165 gfd
h.	pH Operating Range:	6-9 Continuous
i.	Membrane Isoelectric Point:	pH < 4.0
j.	Cleaning pH Range:	1-13
k.	Recovery Rate:	>95%
l.	Maximum TMP:	10 psi
m.	Maximum Backpressure:	15 psi
n.	Nominal Pore Size:	<0.1um
o.	Air Scour Range:	25 SCFM per stack
p.	Diffuser Type:	Coarse Bubble

6. Manufacturer and Model:

- a. Ovivo,
- b. Cerafiltec,
- c. No substitution is permitted.

C. Permeate Pump

1. Permeate pumps are typically required. These pumps shall meet the following performance requirements.

- a. Pumps shall be sized to handle peak instantaneous flow as defined in this Specification.
- b. Pumps will be inverter-duty rated and operate via Variable Frequency Drives provided by others.
- c. Subsystem controls will be integrated into the PLC and SCADA within the Plant Panel.
- d. Motor controls and HOA will be integrated into the Plant MCC (by others).
- e. Pumps shall be provided inclusive of check valves, isolation valves, inlet and outlet pressure gauges, and expansion joints.
- f. Pumps shall be Centrifugal.
- g. Design Basis
 - 1) Type: Centrifugal Dry Mount
 - 2) Service: Permeate Clean Water
 - 3) Design Flow Permeate: 694 gpm each pump
 - 4) Design Discharge Head: 35.8 psi
 - 5) Motor size: 5 hp
 - 6) Motor Voltage: 460VAC/3PH/60Hz
 - 7) Motor Enclosure: TEFC

D. Manufacturer and model:

- 1. Grundfos | model 80951VSM
- 2. No substitution is permitted.

E. Air Scour Blower

- 1. Blower shall be provided for backwash air scour and shall be sized such than sufficient scfm to support complete mixing. The blowers shall meet the following performance parameters.
 - a. Blower shall be rotary lobe type
 - b. Blower will be inverter-duty rated.
 - c. Blower shall be provided complete with pressure relief valves, check valves, motors, pressure gauges, and mounting equipment.
 - d. Design Basis
 - 1) Service: Backwash Air Scour
 - 2) Discharge Pressure: 4.8 psig

- 3) Inlet Temperature: 25°F to 104°F
- 4) Relative Humidity: 80%
- 5) Max rated Temp Rise: 130°F
- 6) Design Flow Rate: 450 scfm
- 7) Motor size: 15 HP
- 8) Motor Voltage: 460VAC/3PH/60Hz
- 9) Motor Enclosure: TEFC

2. Manufacturer and Model:

- a. Aerzen | Delta Blower Generation 5, GM 15L-DN-100-P
- b. No substitution is permitted.

F. Membrane Cleaning Systems

- 1. Cleaning systems shall be provided for membrane recovery. The system shall meet the following performance parameters.
 - a. The Fully Automated Cleaning Systems shall include backwash, chemically enhanced backwash, maintenance clean, and recovery clean systems.
 - b. Cleaning Systems shall be inclusive of all chemical feed day tanks, chemical feed pumps, valves, instrumentation, injection quills controls, and all other ancillary equipment necessary for a complete cleaning operation.
 - c. Supplier shall define space to be allotted for all cleaning systems, including space for:
 - 1) Chemical storage
 - 2) Mix tanks
 - 3) Cleaning system equipment
 - d. The system shall be designed to clean the membranes in-place without requiring their removal from tanks.
 - e. The cleaning systems shall be sized to clean one Membrane train at a time and allow the other Membrane trains to remain in production. The remaining trains online must hydraulically treat 100% of design flow at all times during the cleaning event.
 - f. All components of the cleaning systems shall be compatible with cleaning solutions recommended by the Supplier for its system.
 - g. Design Basis (Sodium Hypochlorite Clean)
 - 1) Service: Membrane cleaning
 - 2) Design Flow Rate: TBD by mfr

- 3) Max Discharge Pressure: 30 psi
- 4) Motor size: 0.5 HP
- 5) Motor Voltage: 115VAC/1PH/60Hz

h. Design Basis (Citric/Oxalic Acid Clean)

- 1) Service: Membrane cleaning
- 2) Design Flow Rate: TBD by mfr
- 3) Max Discharge Pressure: 30 psi
- 4) Motor size: 0.5 HP
- 5) Motor Voltage: 115VAC/1PH/60Hz

2. Manufacturer and Model:

- a. Sodium Hypochlorite | Watson Marlow / Qdos H-Flo 300
- b. Citric/Oxalic Acid | Watson Marlow / Qdos H-Flo 300
- c. No substitution is permitted.

G. Air Removal and Priming System

- 1. Each Membrane Train shall include a system to remove air and prime the permeate piping.
- 2. The air removal system shall allow air to be removed from the permeate system passively while the Membrane Basin is being filled, through a valve that is opened for this purpose. This valve shall also open during backwash to enable removal of air that may accumulate in the permeate piping during the filtration cycle.

H. Direct Integrity Testing (DIT) System

- 1. A system shall be provided to independently directly test the integrity of each Membrane Train. The system shall include an oil free scroll compressor with duty/standby compressor heads and a compressed air dryer.
- 2. The results of each DIT, including a log removal value (LRV), shall be determined by the PLC and displayed on the HMI.

I. Valves

- 1. General.
 - a. Valves and actuators are to be furnished in accordance with the requirements of the specification.
 - b. Supply all necessary valves and actuators required for a completely functional, fully automated system.

- c. Control Valves and actuators associated with the system, as specified, are to be furnished by the System Supplier, unless otherwise noted.
 - d. All valves shall be NSF 61 certified.
- 2. Butterfly Valves
 - a. Butterfly valves shall have a ductile iron or cast iron body, nylon-coated ductile iron disc, 416SS stem, and an EPDM seat.
 - b. Manual valves shall have a lockable handle.
 - c. Manufacturer and Model:
 - d. Dezurik
 - e. Or approved equal.
- 3. Ball Valves
 - a. Ball Valves shall have a PVC body PTFE backed with FKM.
 - b. Manufacturer and Model:
 - 1) Asahi Type 21
 - 2) Or approved equal.
- 4. Actuated Valves
 - a. Electric Actuated Valves shall be provided for the service that they will be installed in.
 - b. Manufacturer and Model
 - 1) Bray, Series 70
 - 2) Bettis, EM300
 - 3) Asahi Actuator Series 79
 - 4) Or approved equal.

J. Instrumentation

- 1. General.
 - a. Analytics will provide system measurements used for operational control and adjustments.
 - b. Subsystem components shall be loose shipped and installed by contractor.
 - c. Subsystem controls will be integrated into the PLC and SCADA within the system Panel.

2. Turbidimeter.

a. The turbidimeter shall be provided for indirect membrane integrity and effluent quality monitoring.

b. Sensor.

1) Measures turbidity to effectively monitor the quality filtered water.

2) Design Basis:

a) Service: Various

b) Type: Laser Turbidimeter

c) Local Display: On Controller

d) Flow Rate Sample: 3 to 15.6 gph

e) Measurement Range: 0 to 100 NTU

f) Accuracy: ± 0.008 NTU $\pm 1\%$ of Reading

g) Ambient Temperature: 36 to 104°F

h) Sample Temperature Maximum: 50°C

i) Supply Voltage: 24VAC

3) Manufacturer and Model:

a) HACH UltraTurb

b) No substitution is permitted.

c. Controller.

1) Multi-channel controller that operates one or two sensors.

2) One controller may be combined with additional types of analytic sensors.

3) Design Basis:

a) Service: Various

b) Type: Digital Controller

c) Local Display: Yes, 160 x 240 pixels

d) Sensor Inputs: 0.05 to 0.26 gpm

e) Measurement Range: 0 to 1,000 NTU

f) Accuracy: ± 0.008 NTU $\pm 1\%$ of Reading

g) Input/Output: 4-20 mA

- h) Digital Communication: MODBUS 232/485 Profibus
- i) Ambient Temperature: 36 to 104°F
- j) Sample Temperature Maximum: 50°C
- 4) Manufacturer and Model:
 - a) HACH sc4500
 - b) No substitution is permitted.

3. Flow Meter

- a. Flow measurement shall be sampled continuously. This provides for operational data recording and adjustments to control the various subsystems.
- b. Flow meter shall be an electromatic type.
- c. Grounding rings provided by membrane supplier. Cables shall be provided by the Contractor.
- d. Local read out on the meter shall be provided by membrane supplier.
- e. Design Basis
 - 1) Service: Various
 - 2) Type: Electromagnetic
 - 3) Local Display: On Controller
 - 4) Flow Rate Sample: 60 gpm
 - 5) Measurement Range: 600 gpm to 19,000 gpm
 - 6) Accuracy: ±0.5% mg/L
 - 7) Operating Temperature: 8 to 80°C
 - 8) Supply Voltage: 24VAC
- f. Manufacturer and Model:
 - 1) E+H Promag
 - 2) Rosemount
 - 3) Or approved equal

K. Piping

- 1. Air scour piping shall be Schedule 10 304 stainless steel.
- 2. Permeate piping shall be Ductile Iron Pipe .

3. Spray wash piping shall be Schedule 80 PVC.
4. Piping shall typically have welded, glued, flanged, or mechanical groove (Victaulic) connections. Connections between in-basin piping and concrete wall penetration piping shall typically be Straub-style couplings, in order to ensure a complete seal even in the event of slight misalignment of the piping, under both vacuum and positive pressure environments.
5. Pipe supports shall be 316 stainless steel Unistrut (or equivalent) systems or 316 stainless steel angle and structural shapes with stainless hardware, clamps, and guides
6. Transitions from Ceramic Membrane Supplier piping to Contractor's piping shall use ANSI 150 pound flanges unless otherwise noted or coordinated with the Contractor.
7. Insulation, heat tracing, labeling and/or painting shall be provided by the Contractor

L. CERAMIC MEMBRANE SYSTEM CONTROLS

1. The control panel will house the system PLC and valve Open/Close/Auto switches. The control panel PLC is to be sized to handle all I/O for components in the Ceramic Membrane Supplier's scope as indicated on the P&IDs.
2. The System shall include one Operator Interface containing graphical representations of all equipment and instrumentation and indication and trending of all process values.
3. The Supplier shall be responsible for updating programming for the Ceramic Membrane System PLCs, database creations and generation of all graphic display screens, alarm configurations and trends for the operator stations.
4. Integrator shall reasonably demonstrate the basis for programming in the context of proven, standardized logic including applicable sub-routines, addressing strategy and nomenclature.
5. Human Machine Interface (HMI) or Graphical User Interface (GUI) screens shall be configured to accurately represent the process and process flow.
6. Representative HMI screenshots shall be provided that accurately represent the navigation and functionality of the proposed system.
7. Integrator shall demonstrate the ability to deliver the desired quality and functionality of PLC programming and HMI configuration by including a minimum of twenty-five similar references all located in United States.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Contractor to install the Ceramic Membrane treatment system per the Manufacturer's installation instructions and details.

3.02 SUPPLIER SERVICES

- A. In addition to the time necessary to complete the requirements established within this specification and elsewhere within the Contract Documents, the Ceramic Membrane System Supplier shall

provide [45] person-days and [6] on-site visits for project execution, plus technical support services after commissioning as detailed below.

Table 3-3 Project Execution Services

Item	Service	Estimated Person-Days	Estimated Trips	Notes
1	Material Inspection	[3]	[1]	Supplier to verify completed shipment of material at unload
2	Mechanical Inspection	[5]	[1]	Per this Section
3	Commissioning	[35]	[3]	Inclusive of clean water testing and seeding support/startup
4	Training	[2]	[1]	Training during Commissioning

Table 3-4 Technical Support Services | After Commissioning

Item	Service	Estimated Person-Days	Estimated Trips	Notes
1	Quarterly Plant Audit, 1st & 2nd year	[8]	[8]	Visit to review current process conditions, electrical and mechanical installations, system controls, and operations of the plant

- B. Time spent remedying equipment deficiencies/problems shall not count toward the listed durations and trips.
- C. Ceramic Membrane System Supplier shall be given a minimum of two-week advance notice prior to the scheduling of any of the listed Services.
- D. All service support shall be provided by a qualified company representative.
- E. Supplier shall provide telephone support following commissioning during normal working hours for the duration of the warranty.
- F. Supplier shall provide a phone number for support during nights, weekends, and holidays in event of an emergency.

END OF SECTION